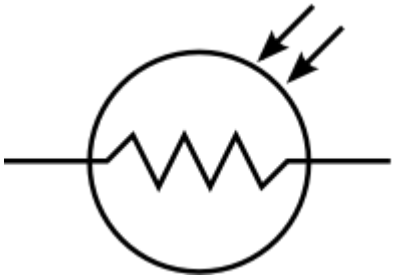
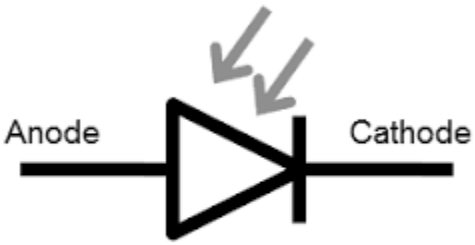
WINTER– 18 EXAMINATION

Subject Name: Basic Electronics & Mechatronics **Model Answer** Subject Code: 17302

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	A	**Attempt any Six**	
	I	**Draw the symbol and label the terminals of** **1) LDR 2) Photo-diode**  **LDR**  Photodiode symbol	1 M each
	ii)	**Define Rectifier. List types of filters used in rectifiers.** It is a circuit which converts AC voltage into DC voltage. Filter types - L- type, π- type	1 M each

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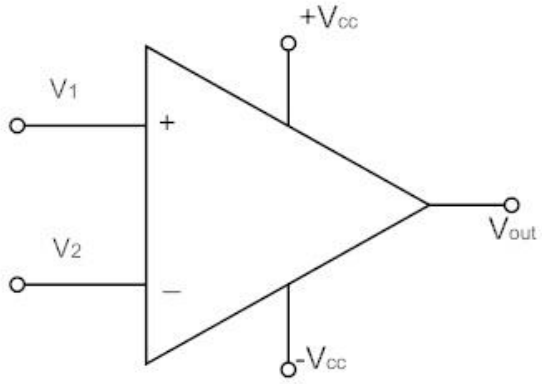
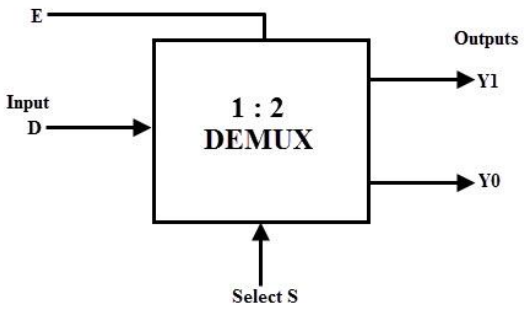
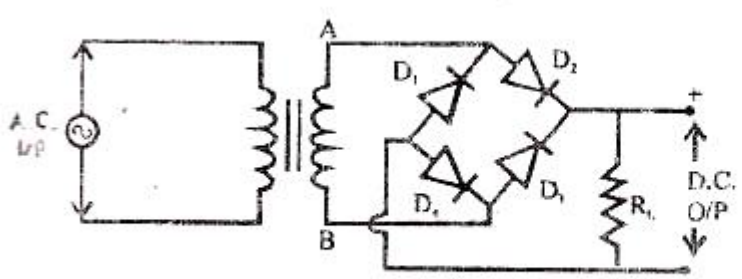
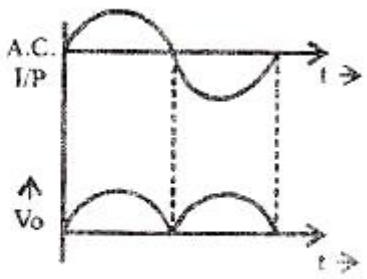
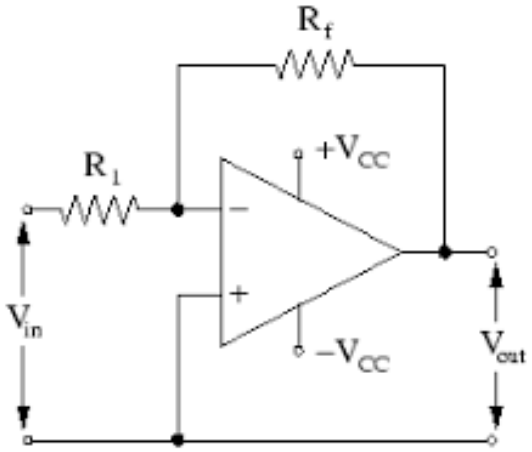
Q. No.	Sub Q. N.	Answer	Marking Scheme
1 A	iii)	**Define thermal runaway** **Thermal runaway** The problem with increasing temperature causing increasing collector current is that more current increase the power dissipated by the transistor which, in turn, increases its temperature. This self-reinforcing cycle is known as *thermal runaway*, which may destroy the transistor.	2 Marks
	iv)	**Draw symbol of OPAMP and label all its terminals**  Op-Amp Symbol	2 Marks
	v)	**Draw logic symbol of 1:2 Demultiplexer. Write truth table also.**  | Select	Input	Outputs	
S	D	Y_1	Y_0
0	0	0	0
0	1	0	1
1	0	0	0
1	1	1	0		1 Mark each

	vi)	**Define transducer. Give its classification.** **Transducer** - It converts one form of signal into another form. A transducer is a device that is used to convert a physical quantity into its corresponding electrical signal. **Classification** - 1. Active transducer 2. Passive transducer	1 Mark each
	vii)	**Write four advantages of FMS (Flexible Manufacturing System)** 1. Large variety of same products 2. Profitable investment. 3. Requires limited inventory. 4. Low labor cost. 5. Flexible system. 6. Speedy production. 7. Improve product quality.	1/2 M For each any 4
	viii)	**Define Mechatronics** **Mechatronics** is a branch of engineering that focuses on designing, manufacturing and maintaining products that have both mechanical and electronic components.	2 Marks
1	B	**Attempt any two**	
	i)	**Draw circuit diagram and I/P, O/P waveforms of full wave bridge rectifier.**  a) Bridge Rectifier  b) Waveforms	Circuit- 2 Marks Wave- 2 Marks

ii) **Draw circuit diagram of inverting amplifier. Calculate gain for inverting amplifier if Rf= 21kΩ and R1 = 3 kΩ.**

Circuit- 2 Marks

Calculation- 2 Marks

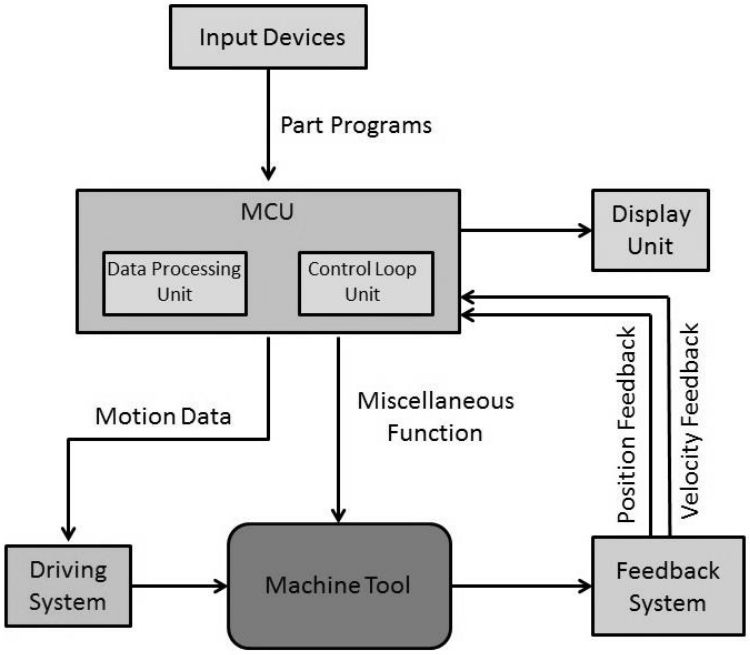


A = Rf / R1 = 21 / 3 = 7

iii) **Draw block diagram of CNC system and state function of each block.**

Dia- 2 Marks

Fun- 2 Marks



(i) Input Devices: These are the devices which are used to input the part program in the CNC machine. There are three commonly used input devices and these are punch tape reader, magnetic tape reader and computer via RS-232-C communication.

(ii) Machine Control Unit (MCU): It is the heart of the CNC machine. It performs all the controlling action of the CNC machine, the various functions performed by the MCU are

- It reads the coded instructions fed into it.
- It decodes the coded instruction.
- It implements interpolation (linear, circular and helical) to generate axis motion commands.
- It feeds the axis motion commands to the amplifier circuits for driving the axis mechanisms.
- It receives the feedback signals of position and speed for each drive axis.
- It implements the auxiliary control functions such as coolant or spindle on/off and tool change.

(iii) Machine Tool: A CNC machine tool always has a slide table and a spindle to control of the position and speed. The machine table is controlled in X and Y axis direction and the spindle is controlled in the Z axis direction.

(iv) Driving System: The driving system of a CNC machine consists of amplifier circuits, drive motors and ball lead screw. The MCU feeds the signals (i.e. of position and speed) of each axis to the amplifier circuits. The control signals are than augmented (increased) to actuate the drive motors. And the actuated drive motors rotate the ball lead screw to position the machine table.

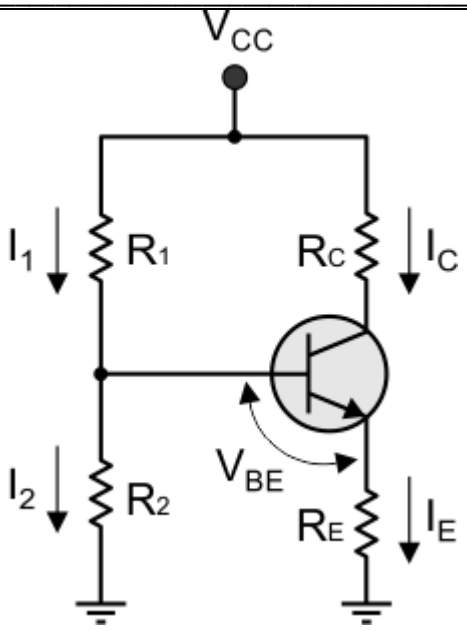
(v) Feedback System: This system consists of transducers that acts like sensors. It is also called as measuring system. It contains position and speed transducers that continuously monitor the position and speed of the cutting tool located at any instant. The MCU receives the signals from these transducers and it uses the difference between the reference signals and feedback signals to generate the control signals for correcting the position and speed errors.

(vi) Display Unit: A monitor is used to display the programs, commands and other useful data of CNC machine.

2 **Attempt any four**

a) **List different biasing methods of BJT. Draw circuit diagram of voltage divider biasing method.** — List- 2 Mark

- Base Bias (Fixed Bias)
- Voltage divider bias
- Emitter bias
- Collector feedback bias

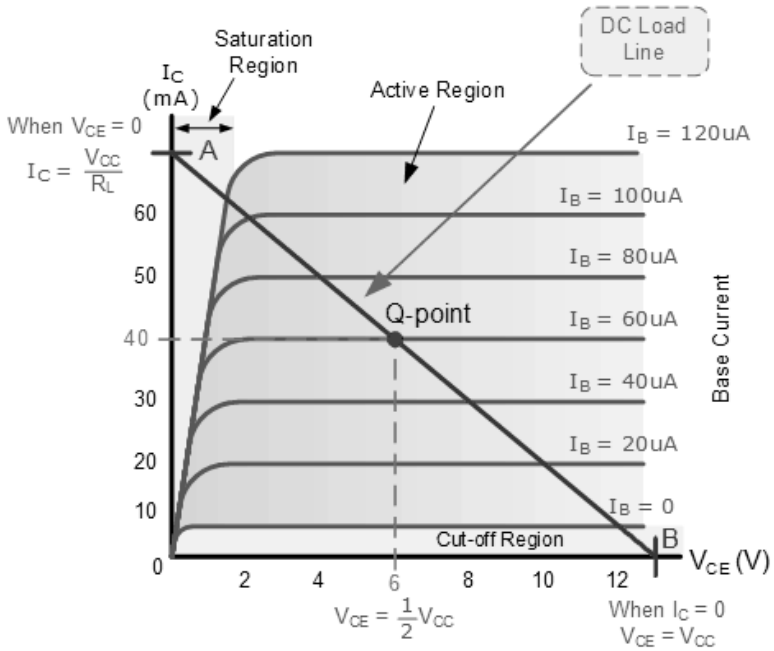


Dia- 2 Marks

b) **Draw the circuit and explain the working of transistor as a switch.**

Transistor is a three terminal semiconductor device that amplify the current and used as a open close switch . Transistors plays a very important role in replacing vacuum tubes. Because transistors are ideal component for using in the digital circuits as switch.

A transistor can be used as a switch because its collector current is directly controlled by the base current . If the base current is greater than 0.7 volts than the transistor acts as a closed switch. To understand this let's take a look of current characteristics of a transistor .



Dia- 2 Marks

Exp - 2 Marks

Fig. Transistor characteristics curve with full details

The characteristic curve above shows the three regions.

- **Saturation region**
- **Cut off region**
- **Active region**

When we are using the transistor as switch we deals with only **saturation region** and **cut off region**.

Transistor in Cut off region :

In the cut off region the base voltage is less than 0.7 V so the base current is also negligible. In the transistor the collector current is directly proportional to the base current. So the collector current Ic is also negligible. But the collector to emitter voltage V_{CE} is maximum. Which creates a large depletion region and no current flows through the transistor. So this region is called as cut off region.

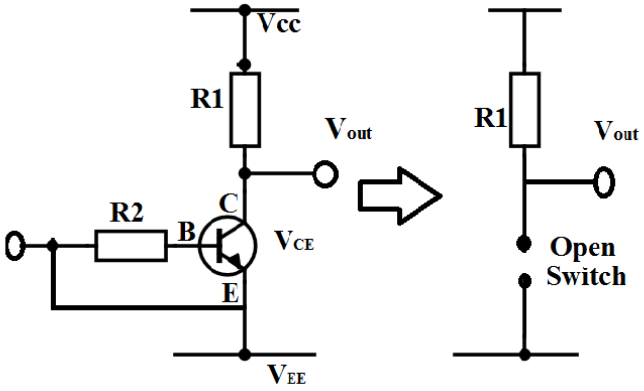


Fig. Transistor in cut off region

The conditions for the transistor in the saturation region are **Vb < 0.7 V, Collector Current (Ic) = minimum, Collector to Emitter Voltage (V_{CE}) = maximum.**

Transistor in Saturation region :

In this mode the maximum base current is applied that results with high collector current and lower collector to emitter voltage. And this results a lower depletion region layer. By this the large amount of current can flow through the transistor.

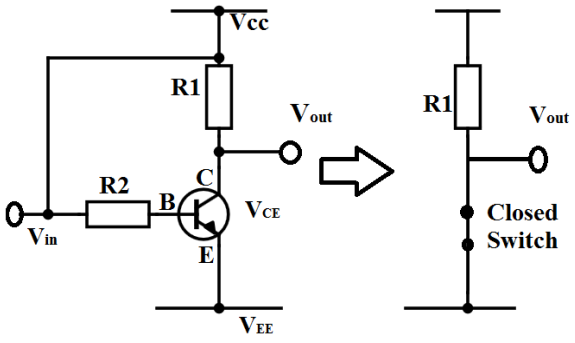
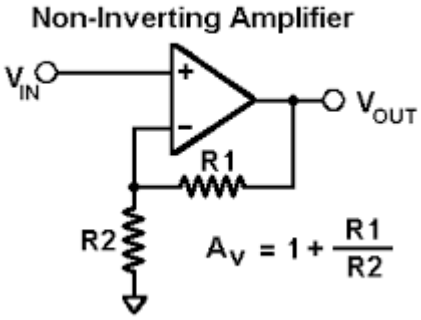


Fig. Transistor in saturation region

The conditions for the transistor in the saturation region are **V_b > 0.7 V, Collector Current (Ic) = maximum, Collector to Emitter Voltage (V_{CE}) = minimum.**

When the base bias voltage is lower than 0.7 V. The transistor operated in the cut off region. But when the base bias voltage increases from 0.7 V the base saturated the collector and the current starts flow. In this state the transistor acts as a closed switch.

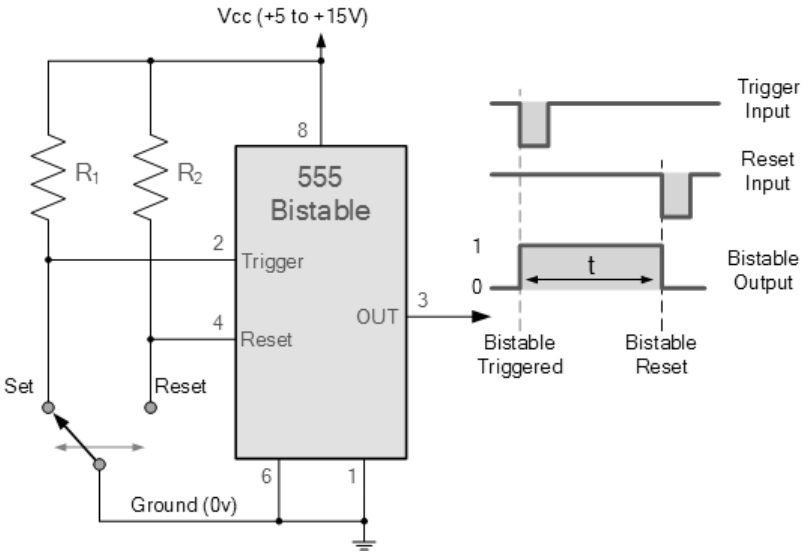
c) **Draw circuit diagram of Non-inverting amplifier. Write its equation for gain.**



Circuit- 2 Marks

Equ- 2 Marks

d) **Draw circuit diagram of Bistable multivibrator using IC-555 and explain its working.**



Circuit- 2 Marks

Working- 2 Marks

The switching of the output waveform is achieved by controlling the trigger and reset inputs of the 555 timer which are held “HIGH” by the two pull-up resistors, R1 and R2. By taking the trigger input (pin 2) “LOW”, switch in set position, changes the output state into the “HIGH” state and by taking the reset input (pin 4) “LOW”, switch in reset position, changes the output into the “LOW” state.This 555 timer circuit will remain in either state indefinitely and is therefore bistable. Then the **Bistable 555 timer** is stable in both states, “HIGH” and “LOW”. The threshold input (pin 6) is connected to ground to ensure that it cannot reset the bistable circuit as it would in a normal timing application.

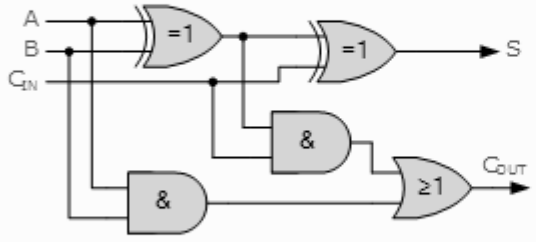
e) **Compare RC and LC oscillator (4-points)**

Sr. No.	RC oscillator	LC oscillator
1.	Frequency of oscillations is dependent of values of R and C.	Frequency of oscillations is dependent on values of L and C.
2.	These are used at low and medium frequencies.	These are preferred at high frequencies.
3.	Example of RC oscillators: Phase shift and wein bridge oscillators	Examples of LC oscillators: Hartley, Colpitt's and clapp oscillators.
4.	Poor frequency stability.	Poor frequency stability except for the clapp oscillator
5.	Used as low and medium frequency signal generators.	Used in radio, TV as high frequency sources, frequency synthesizers.

1 Marks to each point

f) **Draw logical circuit for full adder. Also write truth table.**

Symbol



Truth Table

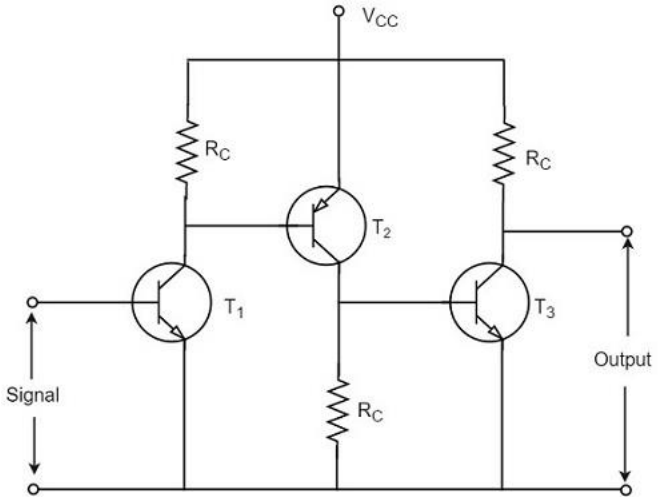
C-in	B	A	Sum	C-out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Circuit- 2 Marks

TT - 2 Marks

3 **DC coupled amplifier:** - There are three types of multi-stage amplifiers. I) RC coupled ii) transformer coupled iii) Direct coupled. So here DC means Direct coupled amplifier.

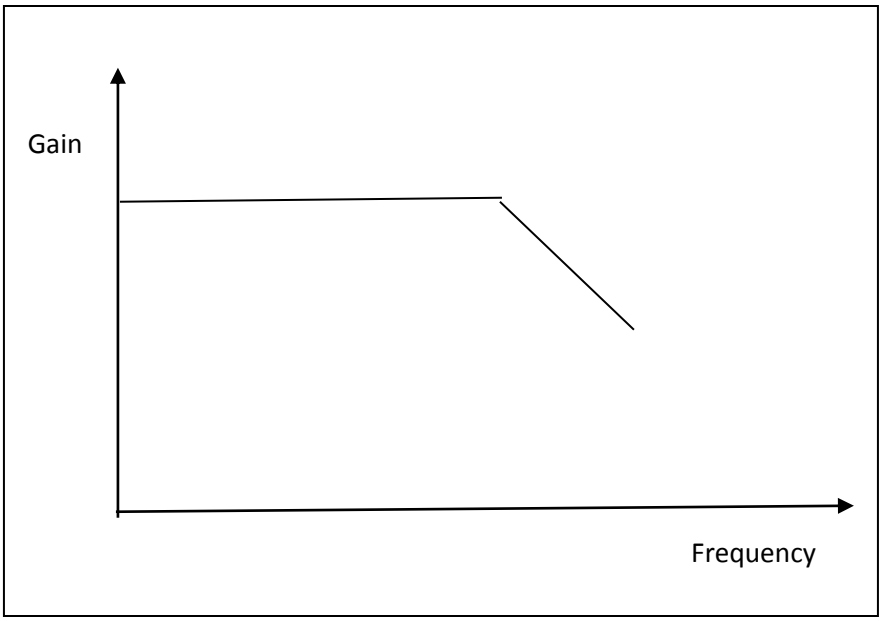
Student may draw 2 stage or three stage amplifier.



02

Circuit shows three stage direct coupled amplifier. It consist of three transistors so it is called as three stage. Output of one stage is directly connected to input of second stage so it is called as Direct coupled. All the capacitors are short circuited in RC coupled amplifier so to get direct cuopled amplifier. These types of amplifiers are suitable for low frequency applications.

Frequency Response:-

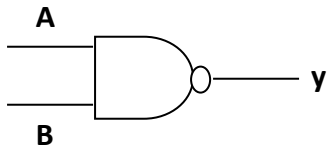


02

b **Symbol and truth table of**

i) NAND Gate

Symbol

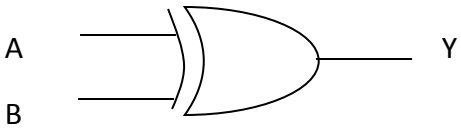


Truth Table 1m

input		o/p
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

1m

ii) XOR Gate 1M

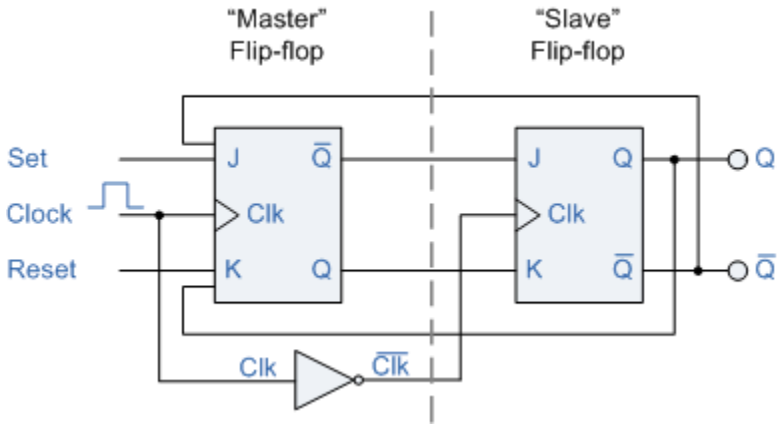


TT

input		o/p
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

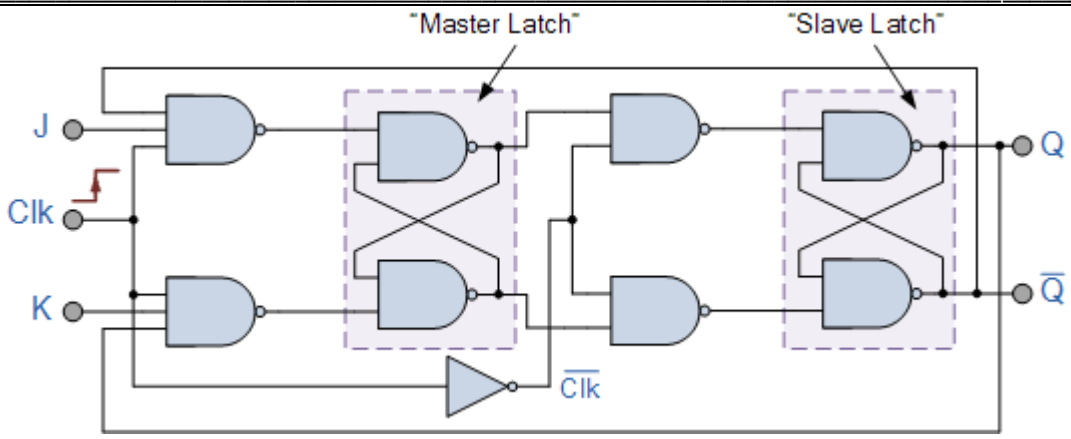
1M

c **JK MS flip flop**



2M

Or student may draw using logic gates



Truth table

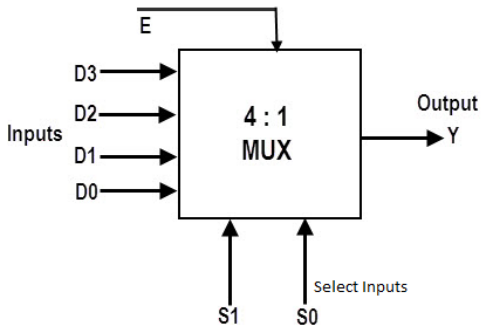
2M

clk	Jm	Km	Qm	$\overline{Qm}$	$\overline{clk}$	Js	Ks	Qs	$\overline{Qs}$
1	0	0	0	1	0	0	1	0	1
0	0	0	0	1	1	0	1	0	1
1	1	0	1	0	0	0	1	0	1
0	1	0	1	0	1	1	0	1	0
1	0	1	0	1	0	1	0	1	0
0	0	1	0	1	1	0	1	0	1
1	1	1	1	0	0	0	1	0	1

Please check the logic. As position of variable get change we gets different table. But answer will remain same.

d **4:1 multiplexer**

02



Functional table

E	S1	S0	Y
0	X	X	0
1	0	0	D0
1	0	1	D1
1	1	0	D2
1	1	1	D3

02

e **Selection Criteria for selection of Transducer (any 4)**

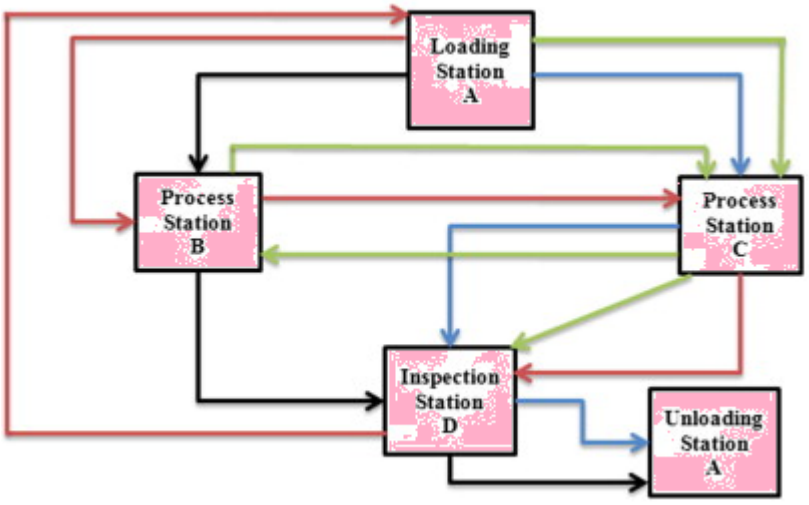
0 1 for each

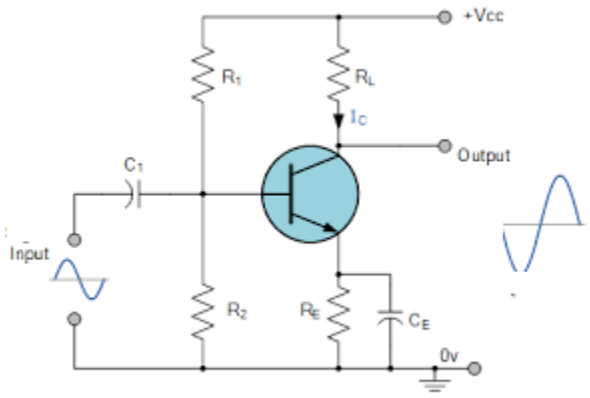
1) Nature of input and output
2) Operating principle
3) Type of transducer
4) Accuracy
5) Size
6) Weight
7) Availability
8) Alternatives

Student may write suitable and relevant point, it may considered.

f **Functional block diagram of FMS**

02



		Student may draw different diagram and explain the same. Depending upon marks and explanation marks are given. FMS flexible manufacturing system.	02
4	a	**Attempt any four** **1) Advantages of PLC (Any 4 points)** **The advantages of PLC are as follows:** 1. Flexible in Nature: One model of PLC can be used for different operations as per requirement. 2. Easy to install and troubleshooting: In hard wired relay based systems, installation time is more as compared to the PLC based control panels. 3. Availability of Large contacts: PLC programming tools contain internal large number of contacts that can be used for any change induced in different applications. 4. Cost effective: Advanced technology and large production of PLC makes it cheaper than the other controller or relay based systems. 5. Simulation feature: PLC programming software comes with the simulation features by default. Student may write different points, if it is suitable and relevant then it is also considered. **2) Application of PLC (any 4 points)** 1.Continuous bottle filling system 2.Batch mixing system 3.stage air conditioning system 4.Traffic control	½*4=2 ½*4=2
	b	**Single stage CE amplifier:**  	02

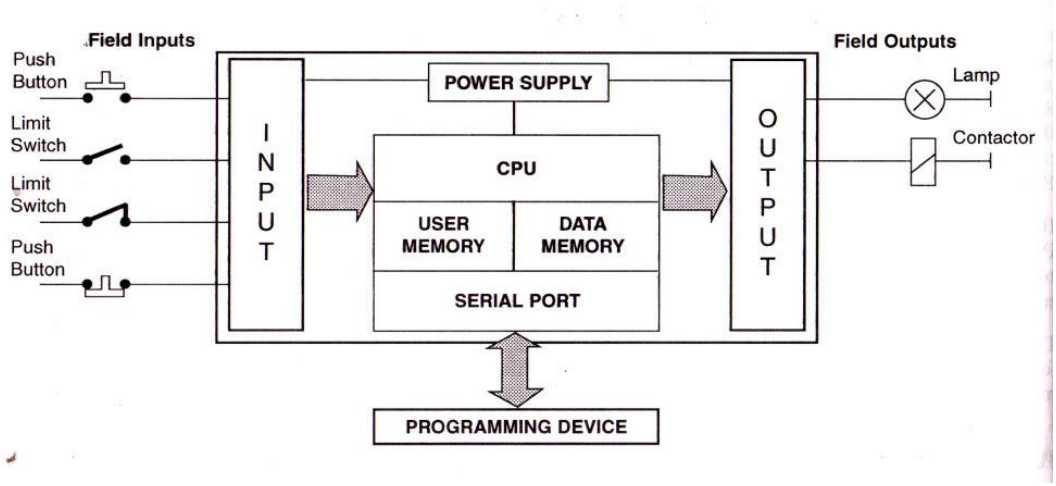
Requirement(Necessity) of Multistage amplifier: -In many applications we required a high gain. But sometimes gain produced by an amplifier is not sufficient so to increase the gain, we have to connect no. of single stage amplifiers in cascade which results in multistage. The main important necessity of multistage amplifier is for providing high gain. 02

It is also required for high bandwidth.

Student may write requirements in terms of points, suitable and relevant point is also considered.

c **Block diagram of PLC and Function of each block:-**

Block Diagram of PLC:- 02



A simplified block diagram of a PLC shown in above Fig. It has three major units/sections.

- I/O (Input/Output) Modules.
- CPU (Central Processing Units).
- Programmer/Monitor.

The input section converts the field signals supplied by input devices/sensors to logic-level signals that the PLC's CPU can read.

The Processor Section reads these inputs, Processes the signal, and prepares the output signals.

The output section converts the logic level output signals coming from processor section to high level signals and used to actuate various output field devices.

The programmer/monitor is used to enter the user's program into memory and to monitor the execution of the program. 02

1) I/O Section:-

The I/O section establish the interfacing between physical devices in the real world outside the PLC and the digital arena inside the PLC.

The input module has bank of terminals for physically connecting input devices, like push buttons, limit switches etc. to a PLC. the role of an input module is to translate signals from input devices into a form that the PLC's CPU can understand.

The Output module also has bank of terminals that physically connect output devices like

solenoids, motor starters, indicating lamps etc. to a PLC. The role of an output module is to translate signals from the PLC's CPU into a form that the output device can use.

The tasks of the I/O section can be classified as:

- Conditioning
- Isolation
- Termination
- Indication

An electronic system for connecting I/O modules to remotely located I/O devices can be added if needed. The actual operating process under PLC Control can be thousands of feet from the CPU and its I/O modules.

2) CPU Section:-

The Central Processing Unit, the brain of the system is the control portion of the PLC. It has three Subparts.

- Memory System
- Processor
- Power Supply

Memory System:-

The memory is the area of the CPU in which data and information is stored and retrieved.The total memory area can be subdivided into the following four Sections.

- I/O Image Memory

User Memory

- Executive Memory

Processor:-

The processor, the heart of CPU is the computerized part of the CPU in the form of Microprocessor / Micro controller chip. It supervises all operation in the system and performs all tasks necessary to fulfill the PLC function.

- It reads the information i.e status of externally connected input devices with input module.
- It stores this information in memory for later use.
- It carries out mathematical and logic operations as specified in application program.
- After solving the user's program, it writes the result values in the memory.
- It sends data out to external devices like output module, so as to actuate field hardware.
- It performs peripheral and external device communication.
- It Performs self diagnostics.

Power Supply:-

The power supply provides power to memory system, processor and I/O Modules.

- It converts the higher level AC line Voltage to various operational DC values.
- for electronic circuitry.

		• It filters and regulates the DC voltages to ensure proper computer operations. **3) Programmer/Monitor:-** The Programmer/Monitor (PM) is a device used to communicate with the circuits of the PLC.The programming unit allows the engineer/technicians toenter the edit the program to be executed. In its simplest form it can be hand-held device with membrane keypad for program entry, and a display device (LED or LCD) for viewing program steps of functions.	
	d	**Types of DAS and its applications: -** 1) Single channel DAS 2) Multi-channel DAS **Advantages of DAS:-** 1) Reduced data redundancy 2) Reduced updating errors and increased consistency 3) Greater data integrity and independence from applications programs 4) Improved data access to users through use of host and query languages 5) Improved data security 6) Reduced data entry, storage, and retrieval costs Any other suitable and relevant point may also considered.	02 02
	e	**Data logger and its application:-** A data logger or data recorder is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). **Application of Data logger (At least 4):-** 1) Unattended gas pressure recording. 2) Road traffic counting. 3) Measure temperatures (humidity, etc.) 4) Process monitoring for maintenance and troubleshooting applications. 5) Process monitoring to verify warranty conditions 6) Water level monitoring. 7) Vehicle Testing (including crash testing) 8) Motor Racing 9) Monitoring of relay status in railway signalling. Other suitable and relevant application may also have considered.	02 1/2*4 = 2M

Comparison of Intrinsic and Extrinsic Semiconductor. (Any four)

f

Intrinsic semiconductor	Extrinsic Semiconductor
Pure form of semiconductor	Impure form of semiconductor
No. electrons and holes are equal	No. of electrons and holes are not equal
Electrical conductivity is low	Electrical conductivity is high
Electrically neutral	Electrically positive or negative in nature.
e.g. Ge, Si semiconductor	e.g. p-type or n-type semiconductor

Any other suitable and relevant point may also have considered.

01 for each

5

Attempt Any Four

a **Define ADC and DAC. Write two applications of each**

ADC(Analog to Digital Convertor):The electronic circuit which converts analog signals into its equivalent Digital form is known as Analog to digital convertor.

Application: 1)In digital instruments

2)In Data Acquisition system.

3)In digital Tachometer

Any other relevant applications may be considered.

DAC(Digital to analog Convertor): The electronic circuit which converts Digital signals into its equivalent Analog form is known as Analog to digital convertor.

Application: 1)In digital processing system.

2)In data Data acquisition system.

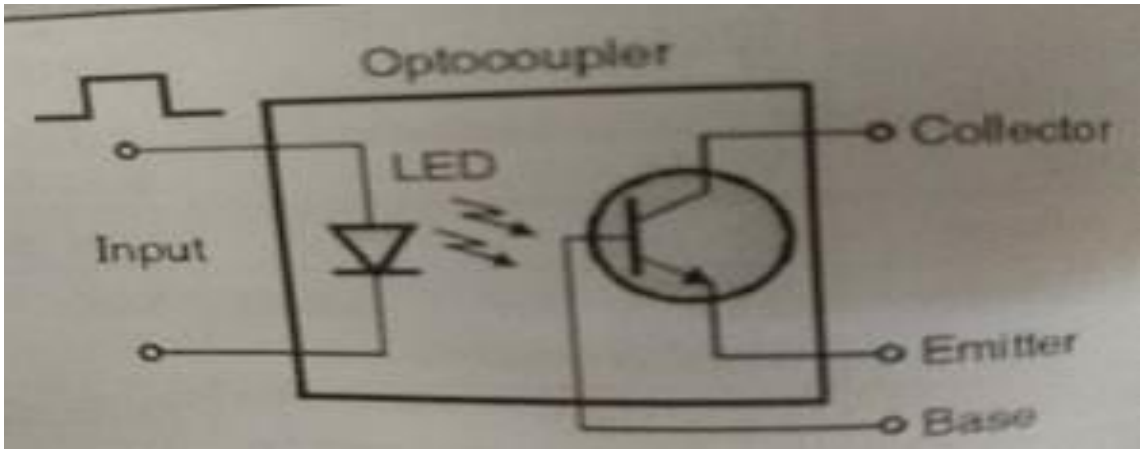
3)In Data logger

Any other relevant applications may be considered.

Definati on:1M each,app lications: 2M each (Any two applicati on)

	b	**With the help of suitable example state concept of active and passive transducer.** **Ans.: Active Transducer:-** Transducers which don't require external power supply for their operation known as active transducer. These are self generating transducer Example 1) Photo Voltaic cell: It produces emf which is directly proportional to intensity of incident light without any external power supply. Passive Transducers:- Transducers which require external power supply for their operation known as active transducer. These are not self generating transducer. Example 1) Strain gauge: Converts pressure into equivalent change in resistance. **Any other relevant examples may be considered.**	02 02
	c	**State two applications each of photo-diode and 7-segment display.** **Applications of photo-diode:-** 1)In cameras 2)In fiber optic receiver 3)in object counting system **Applications of 7-segmet display** 1)In calculators 2)In Wrist watches	02 02
	d	**Write working of opto coupler as an isolator** Optocoupler is as shown in fig. it consist of LED as an light source and phototransistor act as light detector. When input pulse is applied LED turns ON.Light emitted by LED focused on CB junction of phototransistor . In response to this light photocurrent starts flowing which acts as base current of phototransistor.	02

Collector current starts flowing.As input pulse reduces to zero LED turns OFF collector current becomes zero.

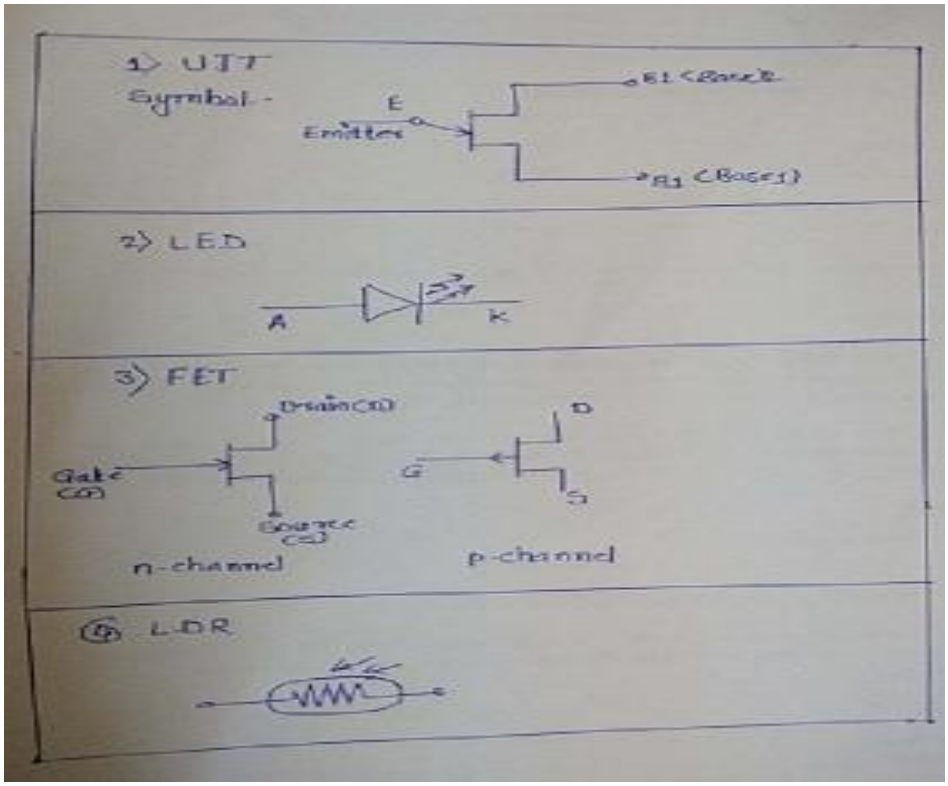


02

e **Compare microprocessor and microcontroller**

Microprocessor	Microcontroller
1)Inbuilt RAM and ROM	1)Do not have inbuilt RAM or ROM
2)Inbuilt timer	2)Doesn't have inbuilt timer
3)I/O ports are available	3)I/O ports are not available it requires extra device such as 8155,8255
4)It has inbuilt serial ports	4) Do not have serial ports
5)Separate Data and program memory	5)Program and data are stored in same memory
6)Many Multifunction pins on the IC	6)less multifunction Pins on IC.

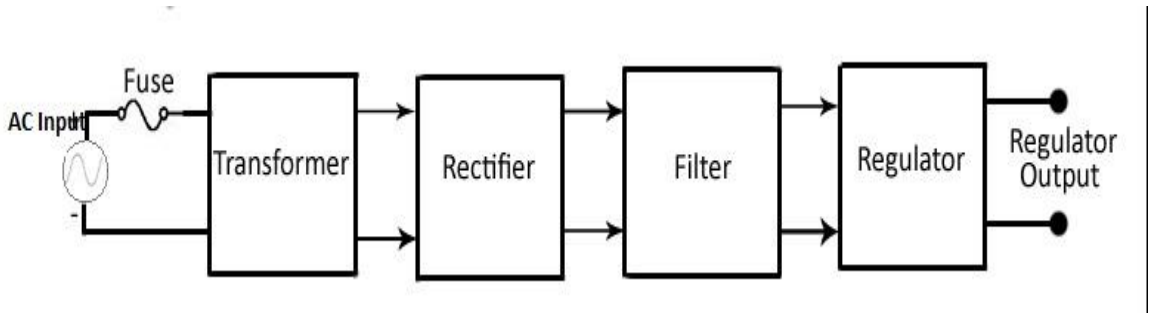
(Any 4 Points 1M each)

	f	**Draw symbol for 1)UJT 2)LED 3)FET 4)LDR** 	**(1M each symbol)**
6		**Attempt any four**	
	a	**Define load regulation and line regulation** Load Regulation: Change in output voltage when the load current is changed from zero (no load) maximum (full load) value is known as load regulation. Load regulation =V_{NL}-V_{FL} Where V_{NL}=output voltage on no load V_{FL}= output voltage on full load % Load regulation = V_{NL}-V_{FL}/ V_{FL} *100 Line Regulation: Change in regulated load voltage due to change in line voltage in a specified range of 230V at a constant load current. Line regulation=V_{LH}-V_{LL} Where V_{LH}=Load voltage with high line voltage	**2M for load regulation and 2M for Line regulation)**

V_{LL}=Load voltage with low line voltage

% line regulation=Line regulation/V_{nom}*100

b **Draw block diagram of regulated power supply. State function of each block**



2M for load regulation and 2M for Line regulation)

Transformer:-AC input voltage is applied to step down transformer which reduces amplitude of ac voltage to required level .

Rectifier: Reduced ac voltage is applied to rectified which converts it into pulsating dc voltage.usually bridge wave rectifier is mostly used.

Filter: Pulsating dc voltage is applied to filter which eliminates ac ripples from signal and convert it into pure dc.

Types of fiter:-C fiter,L filter,LC Filter,CLC Filter.

Regulator:The combination transformer ,rectifier and filter makes unregulated power supply.which gives unregulated power supply to convert it into regulated an regulating element is used which keeps output voltage constant.

c **State Barkhausen criteria for oscillation.State type of oscillators.**

2M Criteria,2 M Types of Oscilllator)

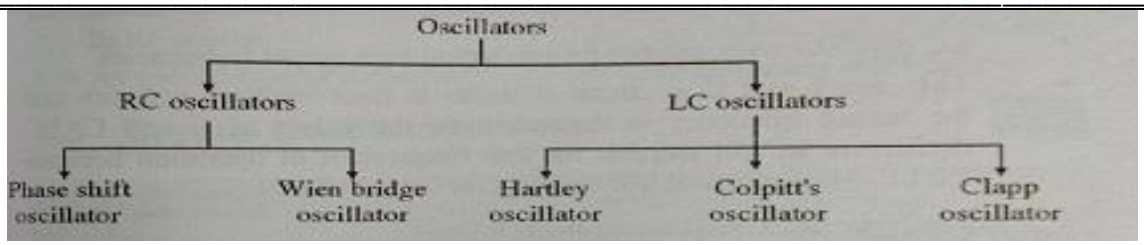
Barkhausen Criteria:

1)Phase shift between input terminal,through the amplifier and feedback network and back again to the input should be 0 or 360 degree.

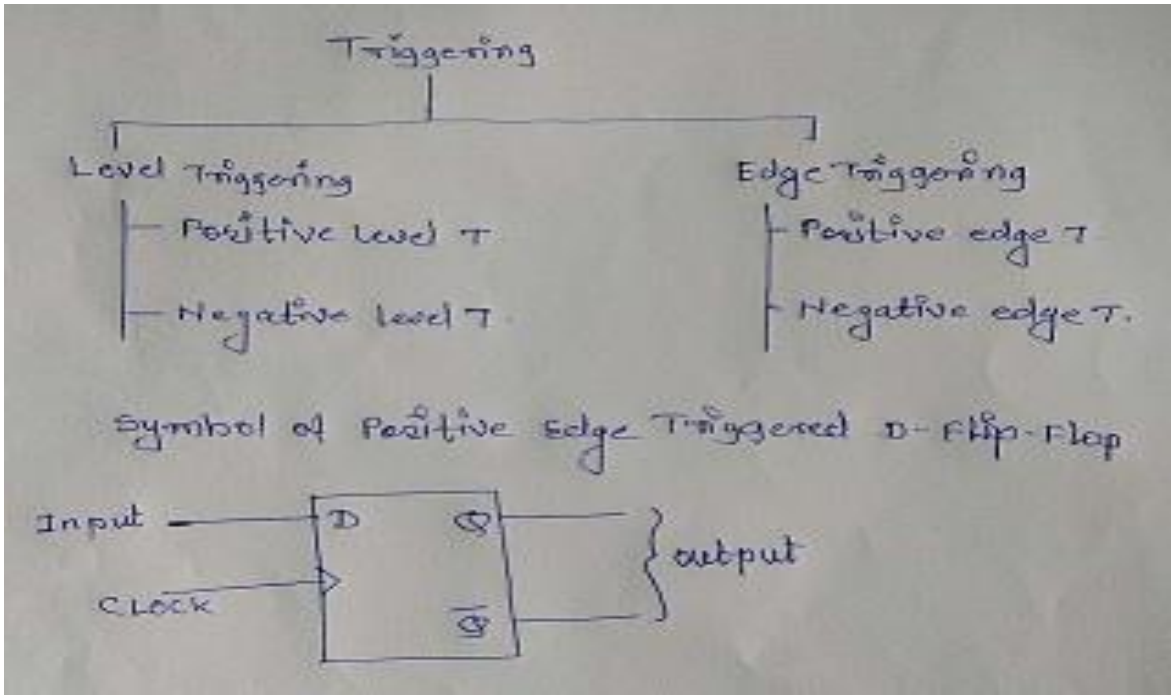
2)The magnitude of product of open loop gain of amplifier A and the feedback factor β is equals to or greater than unity.

$|A\beta| \geq 1$

d

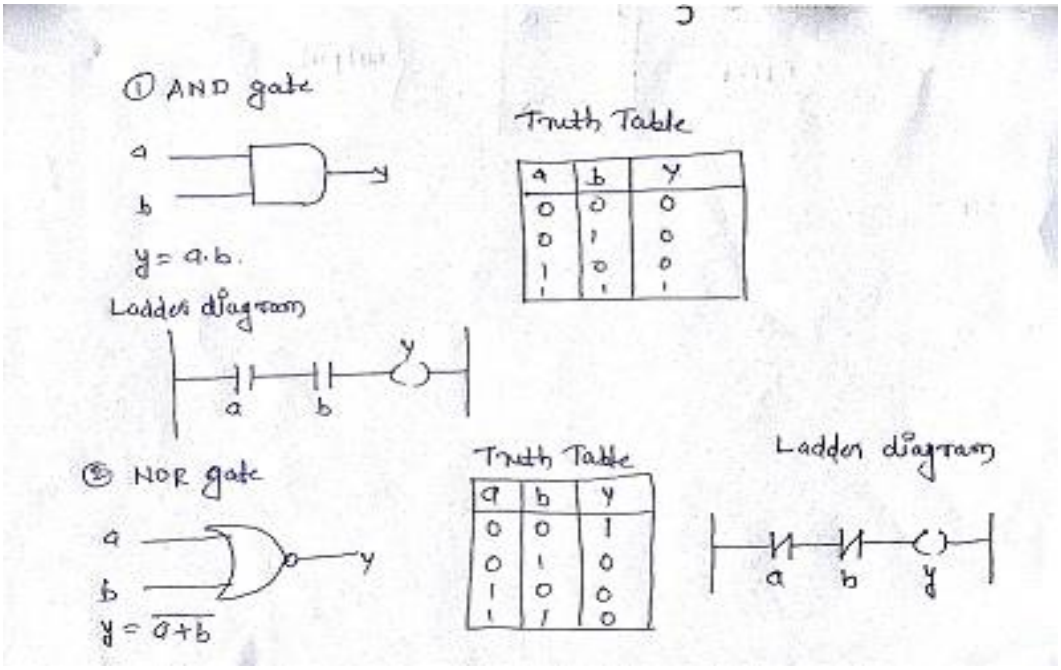
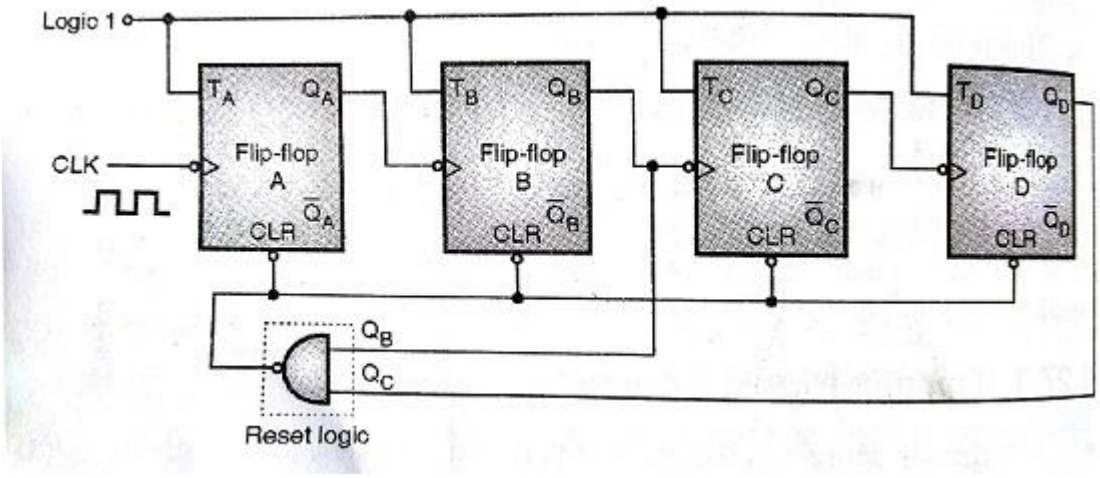


State different triggering method. Draw symbol of D-Flip-flop using positive edge triggering.



2M Method ,

2M Symbol)

	e	**Draw Ladder diagram for 1)AND gate 2)NOR gate** 	**2M Methods ,2M Symbol)**
	f	**Draw internal schematic of decade counter. Also write its Tuth Table.** **Internal schematic of Decade Counter** 	02

Truth Table

Table

CLK	Outputs				Decimal count
	Q_D	Q_C	Q_B	Q_A	
0	0	0	0	0	0
1	0	0	0	1	1
2	0	0	1	0	2
3	0	0	1	1	3
4	0	1	0	0	4
5	0	1	0	1	5
6	0	1	1	0	6
7	0	1	1	1	7
8	1	0	0	0	8
9	1	0	0	1	9
10	0	0	0	0	0

Repeat

02