

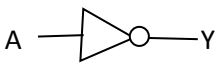
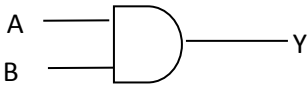
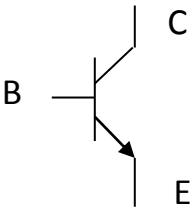
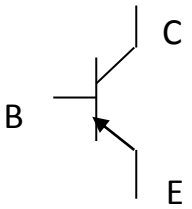
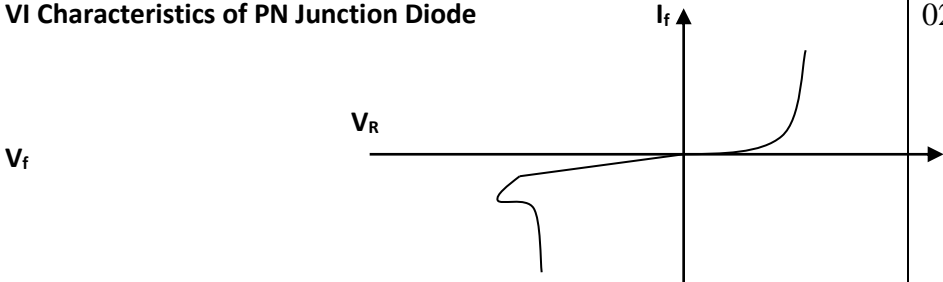


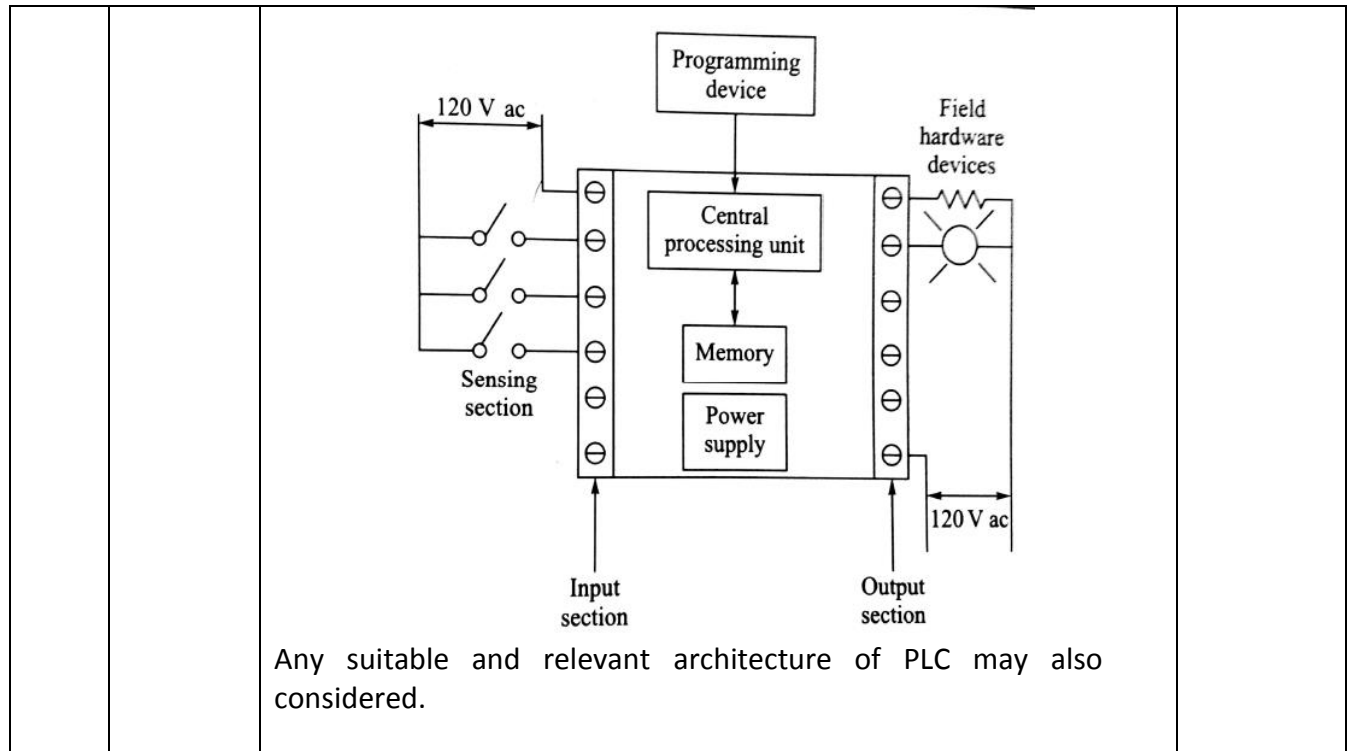
Important Instructions to examiners:

- 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	Model Answer/Solution	Marks		
1	Attempt any <u>SIX</u> of the following:	12		
a)	<p>i Types of Filters</p> <p>i) Series inductor filter ii) Shunt capacitor filter iii) CLC (π) filter</p>	2 marks		
	<p>ii Symbol of LDR and Diode</p> <div style="text-align: center;"> </div>	1 Mark for each symbol		
	<p>iii Types of Oscillators</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>RC Oscillators</p> <p>Wein bridge RC phase shift</p> </td> <td style="width: 50%; vertical-align: top;"> <p>LC Oscillators</p> <p>Colpitt's Hartley Clapp Crystal</p> </td> </tr> </table>	<p>RC Oscillators</p> <p>Wein bridge RC phase shift</p>	<p>LC Oscillators</p> <p>Colpitt's Hartley Clapp Crystal</p>	02 marks (1) Mark for each type
<p>RC Oscillators</p> <p>Wein bridge RC phase shift</p>	<p>LC Oscillators</p> <p>Colpitt's Hartley Clapp Crystal</p>			
	<p>iv Thermal runaway:</p> <p>The self-destruction of a transistor is known as thermal runaway. It is the cyclic process, which destroys the transistor. As temperature increases, transistor leakage current I_{cbo} increases, which in turn increases the collector current I_c due to which again junction temperature increases and so on.</p>	02 marks for appropriate definition		



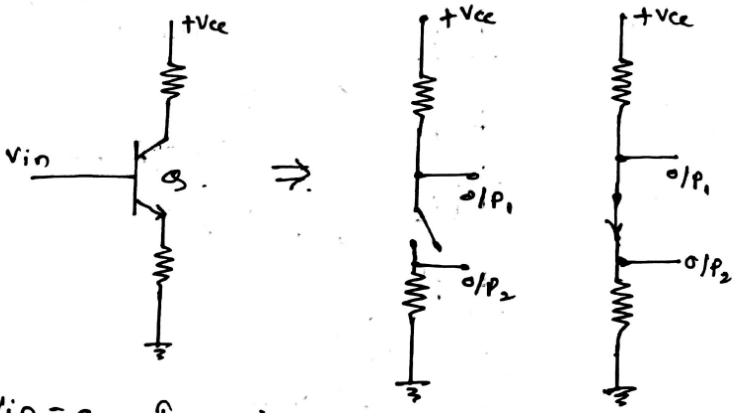
	v	<p>Logical Symbol of NOT and AND gate</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>A ——— Y</p> </div> <div style="text-align: center;">  <p>A ——— B ——— Y</p> </div> </div>	1 Mark for each symbol
	vi	<p>Symbol of NPN and PNP Transistor</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>C B E</p> <p>NPN Transistor</p> </div> <div style="text-align: center;">  <p>C B E</p> <p>PNP Transistor</p> </div> </div>	1 Mark for each symbol
	vii	<p>Intrinsic semiconductor :- This is a pure form of semiconductors available in nature. It has high resistivity. silicon and germanium are the intrinsic semiconductors.</p> <p>Extrinsic semiconductor :- When some impurity is added to a pure semiconductor, the resultant semiconductor is known as Extrinsic semiconductor. Generally trivalent and pentavalent impurities are used to get p-type and n-type semiconductors respectively.</p>	1 Mark for each definition
	viii	<p>VI Characteristics of PN Junction Diode</p> <div style="text-align: center;">  </div>	02
1	B	<p>Attempt any Two</p>	08
	i)	<p>“Programmable logic controller is defined as a sequential logic device that generates output signals” according to the logic operations performed on the input signals.” or PLC is a digitally operated electronic system which used programmable memory for the internal storage of user-oriented instructions for implementing specific functions such as logic sequencing, timing counting and arithmetic to control through analog inputs and outputs, various types of machines or processes.</p> <p>Architecture of PLC</p>	02+02



Q.No	Model Answer/Solution	Marks															
1	B																
ii)	<p>Difference between Microprocessor and Microcontroller</p> <table border="1"> <thead> <tr> <th>Parameter</th> <th>Microprocessor</th> <th>Microcontroller</th> </tr> </thead> <tbody> <tr> <td>Components</td> <td>It is a CPU</td> <td>It consists of CPU, RAM, ROM, I/O ports, timer, Converters</td> </tr> <tr> <td>Access time</td> <td>High</td> <td>Less</td> </tr> <tr> <td>Number of opcodes</td> <td>Less</td> <td>More</td> </tr> <tr> <td>Hardware required</td> <td>RAM, ROM, I/O ports, timer, converters externally.</td> <td>In built</td> </tr> </tbody> </table> <p>Any other relevant point may also be considered.</p>	Parameter	Microprocessor	Microcontroller	Components	It is a CPU	It consists of CPU, RAM, ROM, I/O ports, timer, Converters	Access time	High	Less	Number of opcodes	Less	More	Hardware required	RAM, ROM, I/O ports, timer, converters externally.	In built	<p>4 marks 1 mark for each parameter</p>
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Hardware required	RAM, ROM, I/O ports, timer, converters externally.	In built															
iii)	<p>Non-Inverting Amplifier</p>	<p>02 + 02</p>															



		<p>Given $R_f = 25\text{ K}\Omega$ and $R_1 = 5\text{ K}\Omega$ For non-inverting amplifier gain = $(1 + R_f/R_1)$ therefore Gain = $(1 + 25\text{k}/5\text{k})$ Gain = 6</p>													
Q.No		Model Answer/Solution	Marks												
2		Attempt any four	16												
a)		<p>Difference between Bijunction Transistor and field effect transistor</p> <table border="1"> <thead> <tr> <th>Bijunction Transistor</th> <th>Field Effect Transistor</th> </tr> </thead> <tbody> <tr> <td>It is a current controlled device</td> <td>It is a voltage controlled device</td> </tr> <tr> <td>Input junction is always forward biased</td> <td>Input junction is always reversed biased</td> </tr> <tr> <td>Input impedance is low</td> <td>Input impedance is high</td> </tr> <tr> <td>It has three terminals i.e. Emitter, base, collector</td> <td>It has also three terminals Source, gate and drain</td> </tr> <tr> <td>Types of BJT NPN and PNP</td> <td>Types of FET N-ch and P-ch</td> </tr> </tbody> </table> <p>Any other suitable and relevant point may also considered</p>	Bijunction Transistor	Field Effect Transistor	It is a current controlled device	It is a voltage controlled device	Input junction is always forward biased	Input junction is always reversed biased	Input impedance is low	Input impedance is high	It has three terminals i.e. Emitter, base, collector	It has also three terminals Source, gate and drain	Types of BJT NPN and PNP	Types of FET N-ch and P-ch	1 marks each $1*4=4$
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Types of BJT NPN and PNP	Types of FET N-ch and P-ch														
b)		<p>Instrumentation Amplifier</p> <p>Equation of output voltage $V_O = (V_2 - V_1) R_3 / R_2 \{1 + 2 R_1 / R_g\}$</p>	03+01												
Q.No		Model Answer/Solution	Marks												

2	<p>c) Load and Line regulation</p> <p>Load regulation (2 marks)</p> <p>Load regulation is the capability to maintain a constant output voltage despite changes in the supply's load current from no load to full load.</p> $\% \text{Load Regulation} = 100\% \frac{V_{\min\text{-load}} - V_{\max\text{-load}}}{V_{\text{nom-load}}}$ <p>Line regulation (2 marks)</p> <p>It is the change in the regulated load voltage due to change in line voltage in a specified range of</p> <p>230V \pm10% at constant load current.</p> <p>% Line regulation = VLH – VLL/ Vnom * 100</p>	02+02
	<p>d) BJT as a Switch</p> <p>Transistor as a <u>switch</u>.</p>  <p>$V_{in} = 0$ Transistor is <u>off</u> switch $V_{in} = +V$ Transistor is <u>on</u> switch</p> <p>One may take o/p from <u>collector or emitter</u></p> <p>Case I: When $V_{in} = 0$ then base current of transistor will be zero hence collector current is zero which indicates that the switch is OFF. Case II: When V_{in} is applied then base and collector current flows through the circuit which indicates that the Switch is ON.</p>	02+02



Q.No	Model Answer/Solution	Marks																														
2	<p>e) Ladder Diagram Ladder diagram for start stop logic with one input push button for start and one push button for stop and output motor to activate solenoid valve.</p> <p>S1 – Stop button S2 – Start button M- motor V- Solenoid valve</p> <p>Student may draw different ladder diagram as per his logic, if logic is correct it may also be considered</p>	04																														
	<p>f) Symbol and truth table of AND and NAND Gates</p> <p>AND Gate</p> <table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>Y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>NAND Gate</p> <table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>Y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	A	B	Y	0	0	0	0	1	0	1	0	0	1	1	1	A	B	Y	0	0	1	0	1	1	1	0	1	1	1	0	1 Mark for symbol and 1 mark for Truth Table
A	B	Y																														
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Q. 3 Attempt any FOUR.

a) Sketch pinout diagram of IC 741. Label all the pins and state the functions of each pin.

(Pin diagram with label : 2 marks, function of each pin: 2 marks)

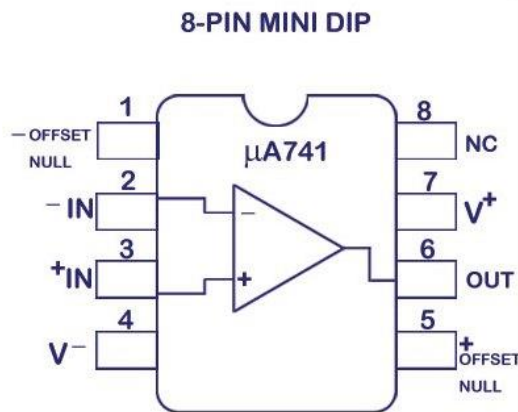


Fig: Pin diagram of IC 741

Functions of each pin :

- Pin 1 and Pin 5 (Offset Null): These Pins are used for offset nulling to compensate for offset voltage.
- Pin 2 (Inverted Input): All input signals at this pin will be inverted at output
- Pin 3 (Non-Inverted Input): All input signals at this pin will be processed normally without inversion.
- Pin 4 (-V): The V- pin (also referred to as V_{EE}) is the negative supply voltage terminal.
- Pin 6 (output) : This pin is used as output terminal.
- Pin 7 (+V): The V+ pin (also referred to as V_{CC}) is the positive supply voltage terminal
- Pin 8 (N/C): The 'N/C' stands for 'Not Connected'. There is nothing connected to this pin

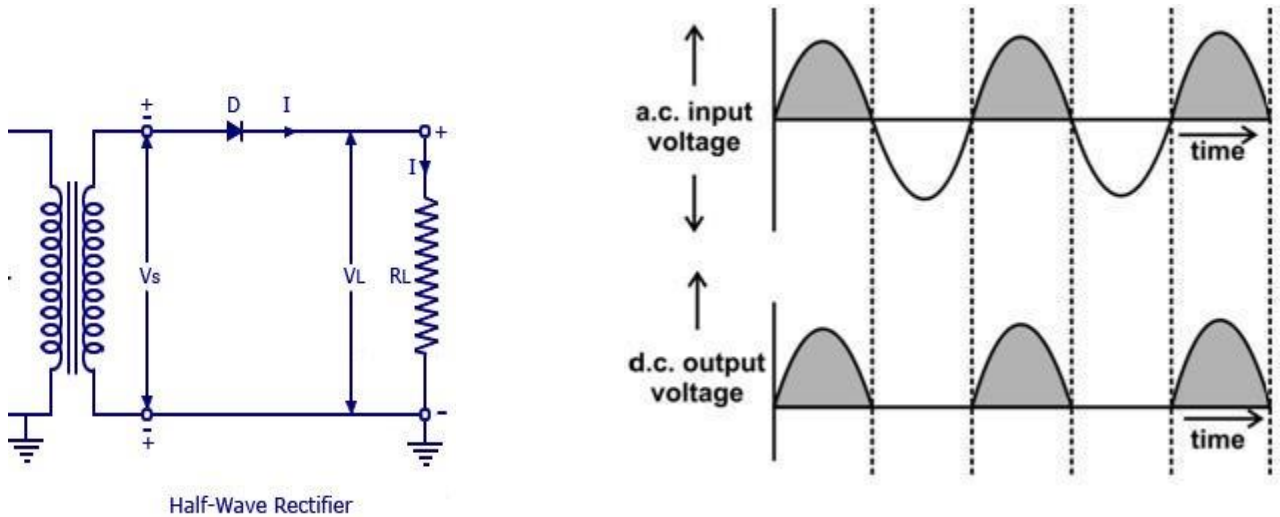
b) Differentiate RC, LC, and crystal oscillator (1 mark for each point)

Parameter	RC Oscillator	LC Oscillator	Crystal Oscillator
component used	Resistor (R) and Capacitor (C)	Inductor (L) and Capacitor (C)	Crystal and capacitor (C)
frequency range	Low and medium	high	high

frequency stability	poor	poor	very high
application	low and medium frequency signal generator	in radio, TV, frequency synthesizers	Crystal clock, frequency synthesizers.

c) Sketch circuit diagram , input and output wave form of half wave rectifier.

(circuit diagram : 2 marks, waveform: 2 marks)



d) What is mechatronics ? state it's any four applications.

(Definition: 2 marks , applications: 1/2 mark each)

Definition : Mechatronics is a synergistic combination of precision engineering, electronic control and mechanic systems. It is the science that exists at the interface among the other five disciplines: mechanics, electronics, informatics, automation , robotics

Applications (Any four)

- Air traffic control
- Time belt in automation
- automatic camera
- automatic machine
- in CNC machine
- used in flexible manufacturing machine (FMS)

- used in Computer Integrated Manufacturing (CIM)
- Used in ROBOTICS.

e) Draw circuit diagram and waveform of Astable multivibrator using IC 555.

(diagram: 2 marks, waveform : 2 marks)

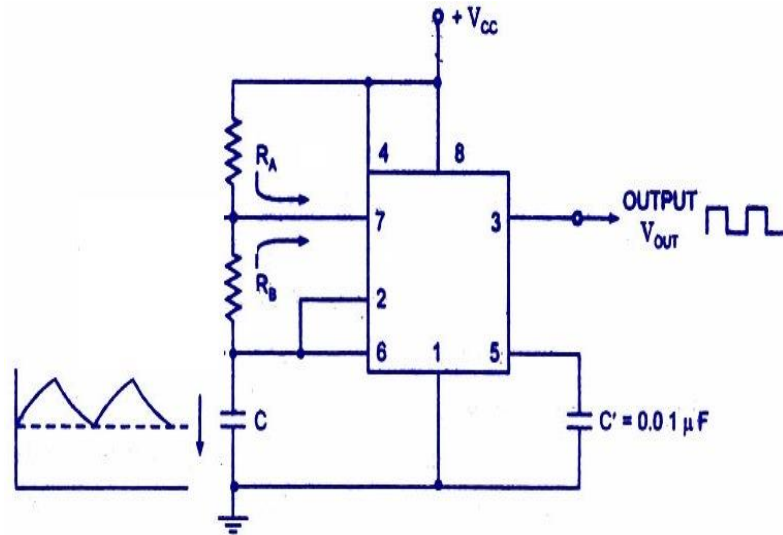


Fig: Astable multivibrator using IC 555

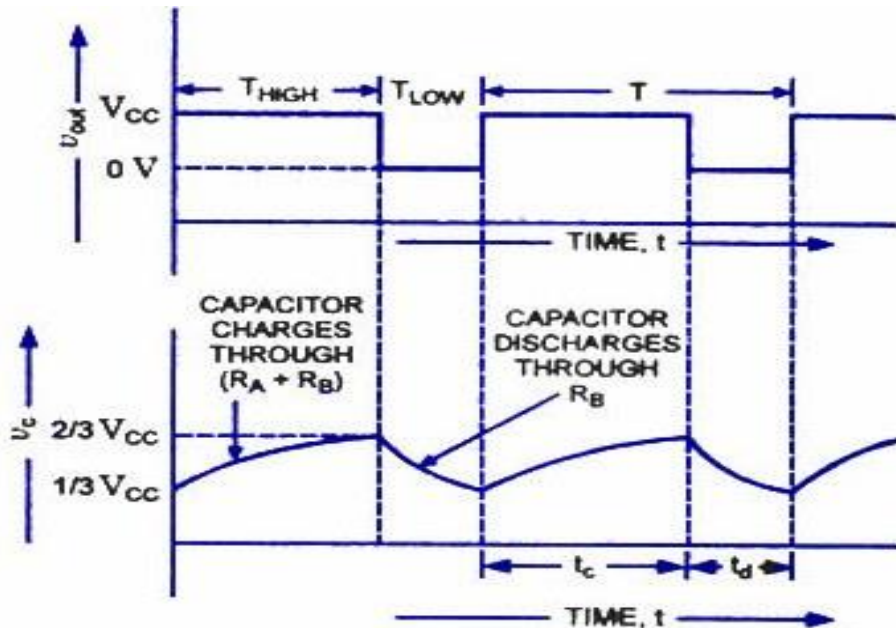
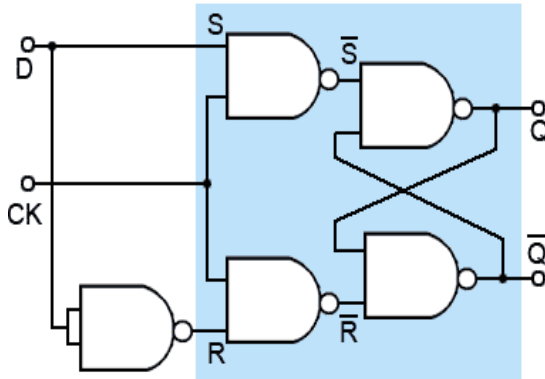


Fig: Waveforms of AMV

f) Illustrate the functions of D flip flop with truth table and logical diagram.

(Diagram: 2 marks, function and truth table: 2 marks)



D- Type flip flop

Inputs		Outputs	
CK	D	Q	\overline{Q}
0	X	No change	
1	0	0	1
1	1	1	0

Truth Table

Function:

- It is also known as delay flip flop.
- it has single data input 'D'
- two inputs (S & R) are connected through inverter.
- from truth table we can say that output follows the input when clock arrives.
- when D is 0 , output will be 0 after arrival of clock pulse.
- when D is 1 , output will be 1 after arrival of clock pulse.

Q 4: Attempt Any FOUR.

a) State the principle of R-2R type DAC and write any two applications of DAC.

(Principle: 2 marks, application: 1 mark each)

Principle: R-2R weighted resistor ladder network uses only 2 set of resistors- R and 2R. If you want to build a very precise DAC. Consider a 4 bit DAC. Digital data $D_3D_2D_1D_0 = 0001$ is input to the DAC . V_{ref} is nothing but the input binary value reference voltage

- Hence output , we will get

$$V_{out} = -\frac{R_f}{R_i} V_{ref} \left[\frac{D_0}{16} + \frac{D_1}{8} + \frac{D_2}{4} + \frac{D_3}{2} \right]$$

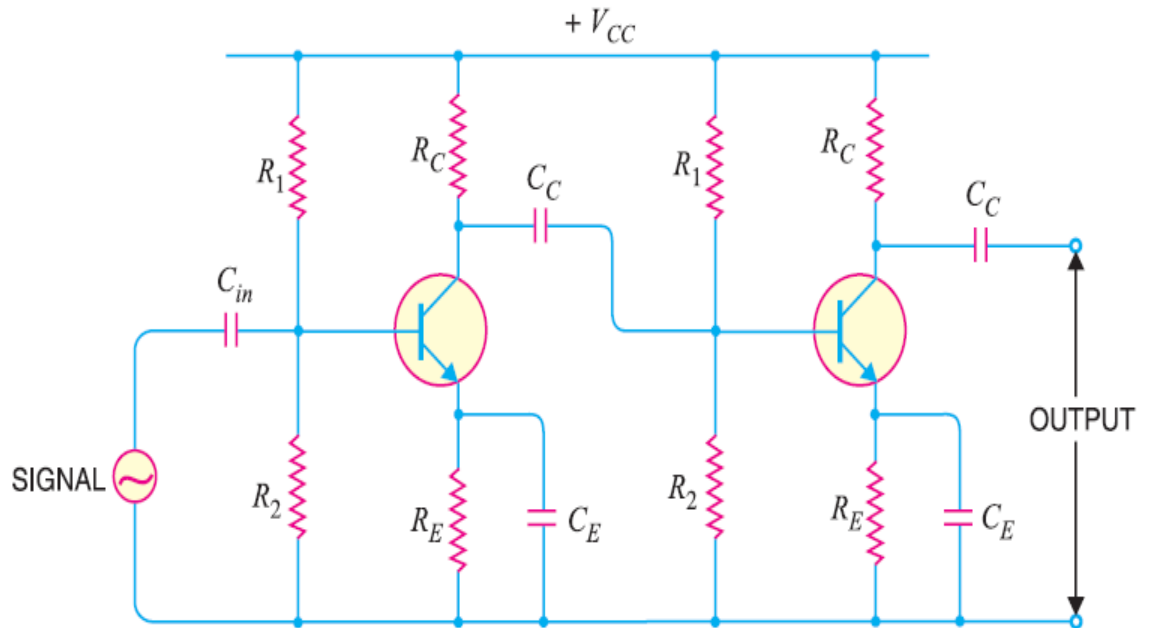
We can build a DAC with any number of bits we want, by simply enlarging the resistor network, by adding more R-2R resistor branches.

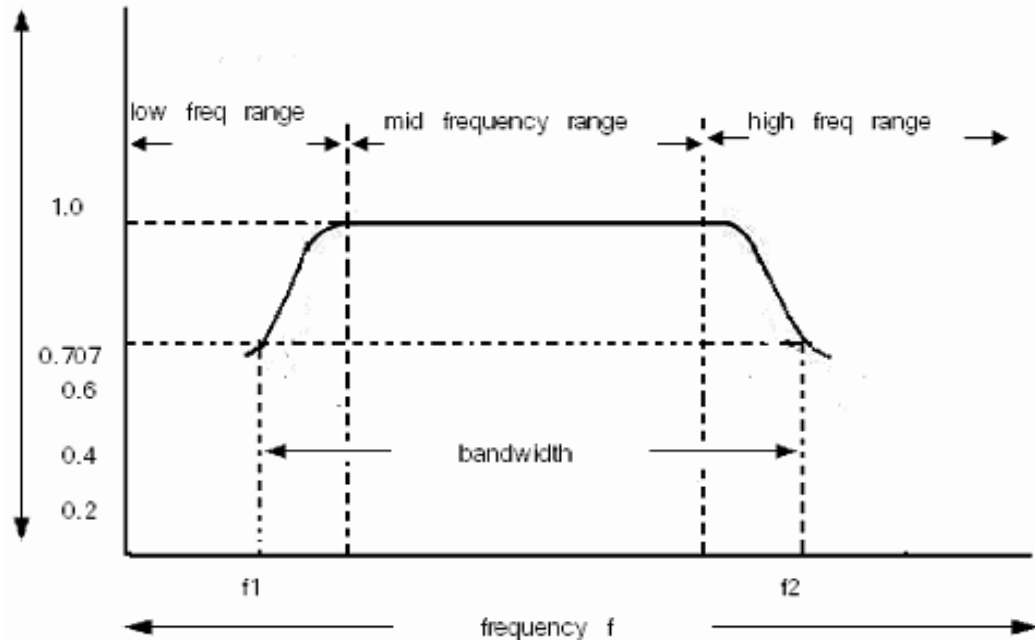
applications: (any two)

- CRT or X-Y plotter display
- Digital tachometer
- In data logger system
- in computers

b) Draw two stage RC couple amplifier and its frequency response

(Diagram : 2 marks , frequency response : 2 marks)





c) What is Data Logger ? State its Application.

(Data Logger: 2 marks, Application: ½ mark each)

Data Logger : A data logger, ” is an electronic instrument that records measurements of the instruments located at different parts of plant at set intervals over a period of time. Data logger measure and record data effortlessly as quickly, as often and as accurately desired.

Applications: (any four)

- power plant
- Petrochemical plant
- cement plant
- AVCS
- fertilizer industries
- oil refinery
- engine testing



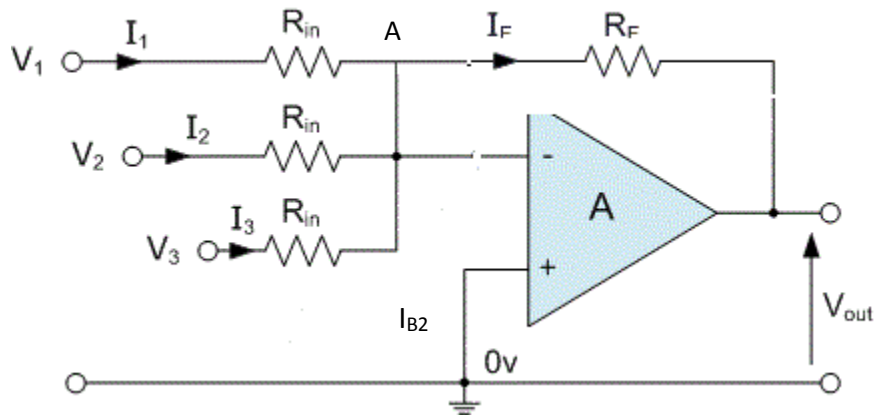
d) Write features of 8085 microprocessor

(any eight features: ½ marks each)

- It is an 8 bit microprocessor
- It is manufactured with N-MOS technology implemented with 6200 transistors.
- It has 16-bit address lines - A0-A15
- The first 8 lines of address bus and 8 lines of data bus are multiplexed AD0-AD7. Data bus is a group of 8 lines D0-D7.
- It provides 5 level interrupts and supports external interrupt request.
- A 16 bit program counters (PC).
- A 16 bit stack pointer (SP).
- It consists of 74 instruction sets.
- It requires a signal +5V power supply
- operates at 3.2 MHZ single phase clock with maximum clock frequency 6 MHz and minimum clock frequency 500 kHz.
- It provides 1 accumulator, 2 flag register, six 8-bit general purpose register arranged in pairs: BC, DE, HL and 2special purpose registers.
- It performs arithmetic and logical operations.
- 8085 microprocessor requires two phase, 50% duty cycle, TTL clock. These clock signals are generated by an internal clock generator
- It generates 8 bit I/O address, hence it can access $2^8 = 256$ input ports and 256 output ports.
- 8085 microprocessor can be used to implement three chip microcomputer (8085, 8155, 8355)

e) Draw and explain circuit of op-amp as adder.

(Circuit diagram: 2 marks, explanation : 2 marks)



Op-amp as adder

Working :

- Fig shows circuit diagram of op-amp as adder
- Here the input voltages V1, V2, V3 are voltages applied to inverting terminal through Rin and Rf is the feedback register.
- Apply KCL at node A, we will have

$$I_1 + I_2 + I_3 = I_{B2} + I_f$$

$$I_1 + I_2 + I_3 = I_f \quad \text{-----} \quad (I_{B2} = 0, \text{ virtual ground concept}) \quad \text{----} \quad (1)$$

- Consider the current flowing through the input resistors are

$$I_1 = \frac{V_1}{R}$$

$$I_2 = \frac{V_2}{R}$$

$$I_3 = \frac{V_3}{R}$$

- the current through Rf is given by $I_f = -\frac{V_o}{R_f}$

Therefore equation 1 became

$$V_1/R + V_2/R + V_3/R = -V_o/R_f \quad \text{or}$$

$$V_o = -R_f/R_{in} (V_1 + V_2 + V_3)$$

if $R_f = R_{in}$ then above equation become

$$V_o = - (V_1 + V_2 + V_3)$$

this is the equation of output of adder we is negative sum of all inputs

f) Draw the block diagram of regulated power supply and write functions of each block.

(Diagram: 2 marks , functions : 2 marks)

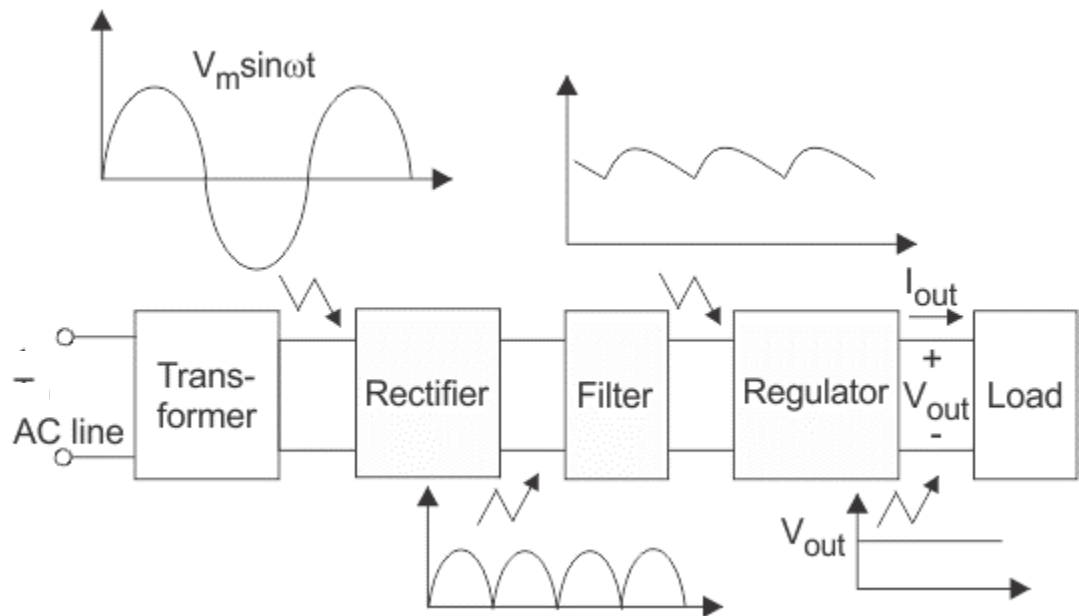


Fig: Regulated power supply

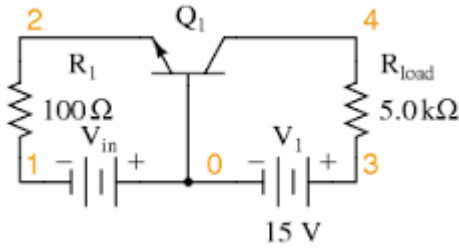
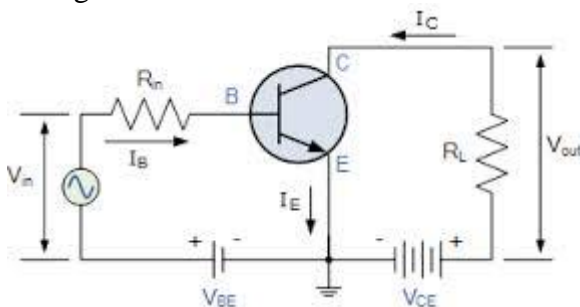
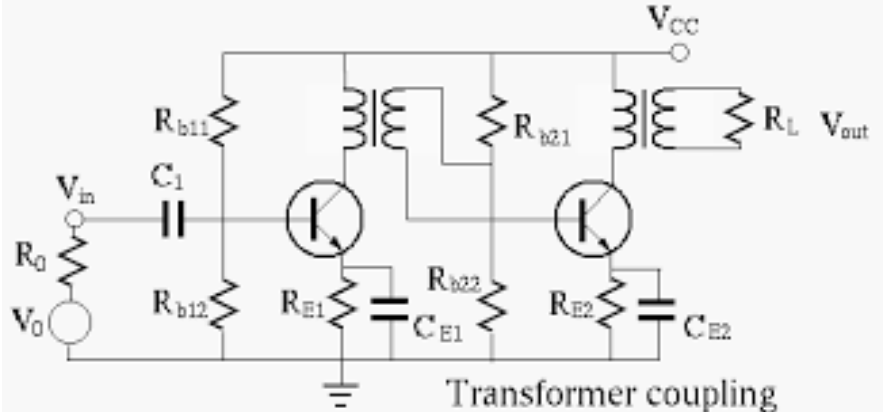
Function:

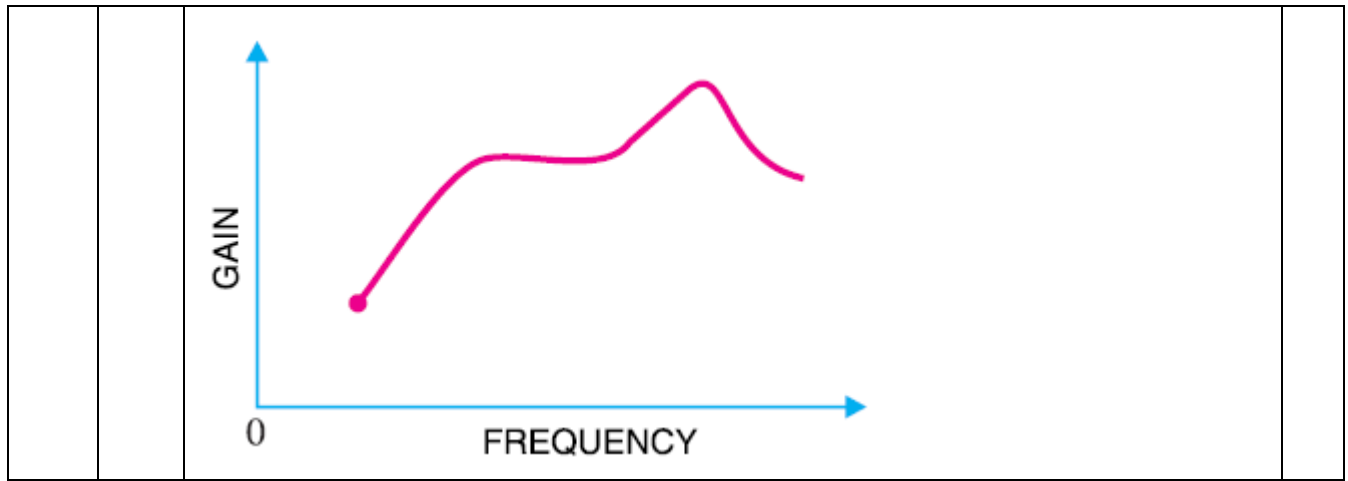
AC supply and transformer: A transformer changes the ac mains (line) voltage to a required value. It is used to step the voltage up or down. Transformer provides isolation from the power line

Rectifier: A rectifier converts ac into pulsating dc. It may be a half-wave rectifier, a full-wave rectifier using a transformer with centre-tapped secondary winding or a bridge rectifier.

Filter: A filter circuit is used remove ripple contents (ac variations) from the rectified voltage. There are four types of filters: 1) Capacitor filter, 2) Inductor filter, 3) L-C filter and 4) π filter.

Voltage regulator: A voltage regulator is necessary to maintain a constant output dc voltage by providing line regulation and load regulation.

<p>d</p>	<p>i) CB configuration of BJT</p>  <p>ii) CE configuration of BJT</p> 	<p>02</p> <p>02</p>
<p>e</p>	<p>Transformer coupled amplifier and its frequency response Consider two stage amplifier.</p>  <p>Transformer coupling</p> <p>Frequency response</p>	<p>02</p> <p>02</p>



f

Logical diagram of 4:1 mux

Truth table of 4:1 mux

S1	S0	Y
0	0	I0
0	1	I1
1	0	I2
1	1	I3

Student may draw logic symbol of 4:1 mux

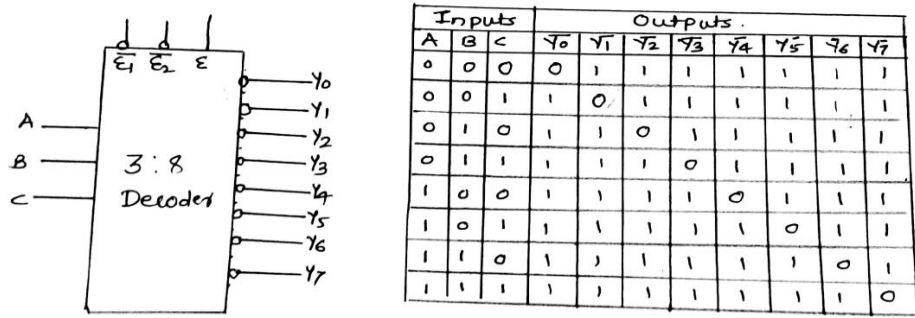
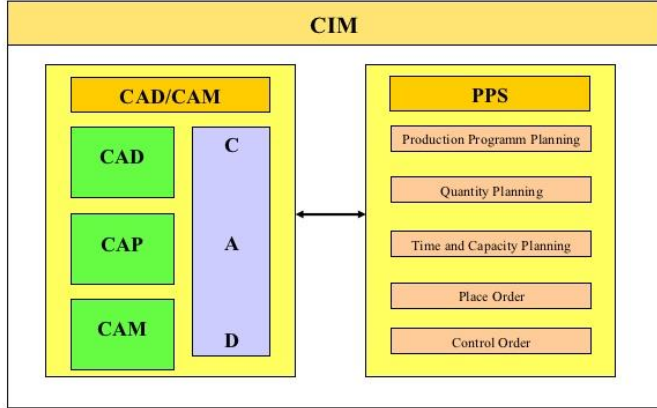
6 Attempt any Four

a **Decoder**:-It is a combination logic circuit used to select a device or decode. Decoders consist of number of inputs (N) and number of output(M) and both are related as

$$2^N \geq M$$

The standard decoders are 1:2,2:4,3:8 and so on.....

3:8 decoder

	 <p>(One may draw with active high output, in that case 0's are active high so replace 'zero' by 'one' and vice versa)</p>	1
b	<p>Factors on which selection of PLC is based</p> <ol style="list-style-type: none"> 1. Number of inputs and number of outputs of PLC. 2. Nature of input and output i.e. Analog or Digital 3. Speed of operation 4. Programming Flexibility 5. Power consumption. 6. Cost of PLC <p>{ any other relevant and appropriate criteria may also considered }</p>	04
c	<p>Concept of CIM</p> <p style="text-align: center;">CIM-Concept</p>  <p style="text-align: center; font-size: small;">business diagram, management model, business graphic, powerpoint templates, business slide, download free, business presentation, business design, business template</p>	04
d	Advance vehicle condition system	04

	<p>Student may explain in the different way, please consider if it is logically relevant. Diagram is not compulsory</p>	
<p>e</p>	<p>Functions and Applications of Robotics</p> <p style="text-align: right;">Explanation is not expected</p> <p>Outer Space – Robotic arms that are under the control of a human being are employed to unload the docking cove of outer-space shuttles to launch satellites or to build a space station.</p> <p>The Intelligent Home – Robotic systems can nowadays scrutinize home safety, ecological circumstances and energy consumption. Door & windows can be unlocked mechanically and electrical device such as lights and A/C can be pre-programmed to turn on. This helps residents to enjoy appliances irrespective of their mobility.</p> <p>Exploration – Robots can enter the environments that are injurious to human beings. An illustration is observing the atmosphere within a volcano or investigating our deep marine life. NASA has utilized robotic probe for environmental study, ever since the early 60's.</p> <p>Military Robots – Flying robot drones are brought into play for close watch in present time's modern armed force. In the future robotic airplane and automobiles could be employed to transmit petroleum, bullets, bombs, etc or clear minefields.</p> <p>Farms – Programmed robots are used by harvesters to cut and collect crops. Robotic milk farms are existing permitting workers to nourish and milk their cattle distantly.</p> <p>The Car Industry – Robotic arms are used, these arms are able to execute numerous tasks in the car manufacturing & assembling procedure. They carry out</p>	<p>02</p>



jobs such as sorting, cutting, welding, lifting, painting and bending. Similar functions but on a minor scale are now being intended for the food industry to execute tasks like- the trimming, cutting and processing of different types of meats like- chicken, beef, fish, lamb, etc.

Hospitals – The development of a robotic suit is under construction that will allow nurses to raise patients without injuring their backbones. Scientists in Japan have crafted a power facilitated suit which will provide nurses the additional power that they need to lift patients.

Disaster Areas – Observation robots built-in with superior sensing and imaging gears. This robot can work in dangerous environments like urban site spoiled by earthquakes by inspecting floors, walls, and roofs for structural reality.

Entertainment – Interactive robots that shows behaviors and education capability. One such robot is owned by SONY which moves around freely, responds to all your commands, carries your luggage and even responds to your oral instructions.

This is not the end of Robotic world; there is many more application of Robotics.

Applications:

Currently, robots perform a number of different jobs in numerous fields and the amount of tasks delegated to robots is rising progressively. The best way to split robots into types is a partition by their application.

1. In Industry–like- material handling, painting, welding and others. If we evaluate merely by application then this sort of robots can also consist of some automatically guided automobiles and other robots.

2. Domestic or household robots – Robots which are used at home. This sort of robots consists of numerous different gears for example- robotic pool cleaners, robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners and other robots that can perform different household tasks..

3. Medical robots – Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots.

4. Service robots – Robots that cannot be classed into any other types by practice. These could be various data collecting robots, robots prepared to exhibit technologies, robots employed for research, etc.

5. Military robots – Robots brought into play in military & armed forces. This sort of robots consist of bomb discarding robots, various shipping robots, exploration drones. Often robots at the start produced for military and armed forces purposes can be employed in law enforcement, exploration and salvage and other

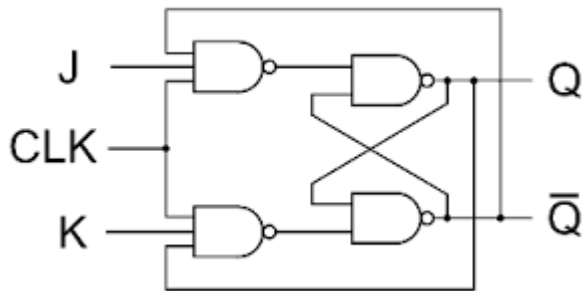


	<p>associated fields.</p> <p>6. Entertainment robots – These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as robosapien or the running photo frames and concludes with real heavy weights like articulated robot arms employed as movement simulators.</p> <p>7. Space robots – I would like to distinct out robots employed in space as a split apart type. This type of robots would consist of the robots employed on Canadarm that was brought into play in space Shuttles, the International Space Station, together with Mars explorers and other robots employed in space exploration & other activities.</p> <p>8. Hobby and competition robots – Robots that is created by students. Sumobots, Line followers, robots prepared merely for learning, fun and robots prepared for contests.</p> <p>Now, as you can observe that there are a number of examples that fit well into one or more of these types. For illustration, there can be a deep ocean discovery robot that can collect a number of precious information that can be employed for military or armed forces purpose.</p> <p>Robotics is a broad field and everyday there is a pioneering invention in the field. Robots were invented by the humans just for fun but by now they are used for assisting humans in various sectors. Human beings are better suitable for multifaceted, imaginative, adaptive jobs, and robots are good for dreary, recurring tasks, permitting human beings to do the harder thinking jobs, whereas a robot is employed for substituting humans for various recurring tasks or entertainment to make living more expedient.</p> <p>Explanation is not expected</p>	
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f

JK Flip-flop using Nand gates

02+02



Race around condition:-

When $J=k=1$ output of Flip flop is toggles at each transition of clock. so it is just like race in '0' and '1'.

Truth Table

J	K	CLK	Q
0	0	↑	Q_0 (no change)
1	0	↑	1
0	1	↑	0
1	1	↑	\bar{Q}_0 (toggles)