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.

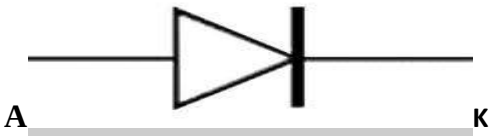
Q.1 a) Attempt any six of the following: 12M

i) Define Knee voltage for P-N junction diode. Draw the symbol for P-N junction diode.

Ans: ***[Note: 1 mark for symbol and 1 mark for definition]***

Knee Voltage for P-N junction diode can be define as point at which diode start conducting this voltage for silicon diode will be .6 volt.

Symbol:



ii) Define intrinsic and extrinsic semiconductor.

Ans: ***[Note: 1 mark for intrinsic and 1 mark for extrinsic]***

Intrinsic Semiconductor

Pure semiconductor is called intrinsic semiconductor.

Extrinsic Semiconductor

Impure or doped semiconductor is called extrinsic semiconductor

iii) Define line and load regulation.

Ans: Line Regulation: **1M**

Line regulation is the capability to maintain a constant output voltage level on the output channel of a power supply despite changes to the input voltage level.

Load Regulation: **1M**

Load regulation is the capability to maintain a constant voltage (or current) level on the output channel of a power supply despite changes in the supply's load.

iv) Which diode is used for 7-segment display? Justify your answer.

Ans: ***[Note: name of diode 1 mark, and justification 1 mark]***

LED, since LED is light emitting diode is emitting light and display should indicate it LED can be used as Display segment.

v) Calculate the frequency of Oscillation for Colpitts Oscillator where L = 1mH, C_1 = 1μf, C_2 = 10 μf.

Ans: ***[Note: 1 mark for formula and 1 mark for answer]***

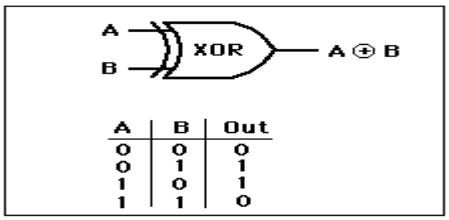
Formula $f = 1/2\prod\sqrt{L\left(\frac{c1c2}{c1+c2}\right)}$

$= 1 \div ((2 * 22 \div 7)\sqrt{(((1/1000) \times 10 \div 11) \div 1000000)})$

$= 5.28khz$

vi) Draw symbol of XOR and XNOR Gates and write Truth-Table for 2-I/P XOR and XNOR Gate.

Ans: EX-OR Gate symbol and truth table **1M**



A	B	Out
0	0	0
0	1	1
1	0	1
1	1	0

EX-NOR Gate symbol and truth table **1M**

Exclusive-NOR gate

A	B	Output
0	0	1
0	1	0
1	0	0
1	1	1

vii) Compare Half Wave Rectifier and Full Wave Rectifier for,

1) Ripple factor

2) Efficiency

Ans: (1 mark for each point)

Half wave Rectifier	Full wave Rectifier
Ripple Factor 1.21	.481
Efficiency 40.5%	80.1%

viii) State the four characteristics of an Ideal OPAMP.

Ans: (Any 4 points- ½ mark each)

Ideal OPAMP:

a)Infinite Bandwidth

b) Infinite Gain

c) Infinite Input Resistance

d) Infinite CMRR

e)zero output Resistance

f) Infinite slew rate

b) Attempt ant two of the following: 8M

i) State four advantages of FET over BJT.

Ans: (Any 4 point- 1 mark each)

a) Voltage Controlled Device

b) Input Impedance (Resistance) is High

c) Small in size

d) Less Power Dissipation

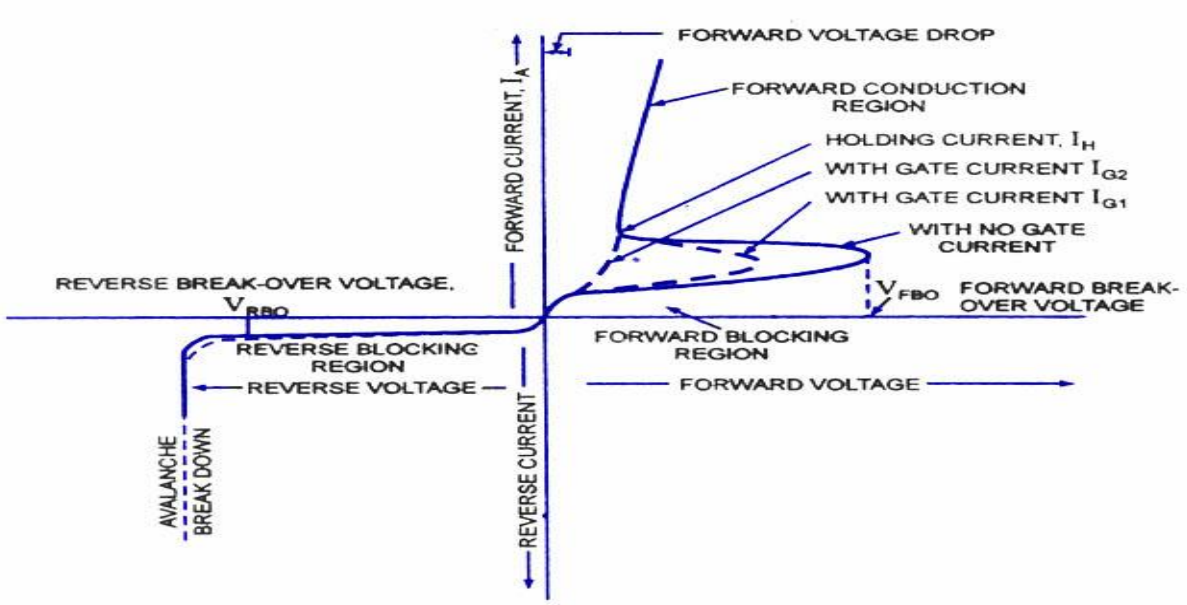
e) Better thermal stability

f) Less offset voltage

ii) Explain the working of SCR with neat diagram. Draw a neat labeled characteristics.

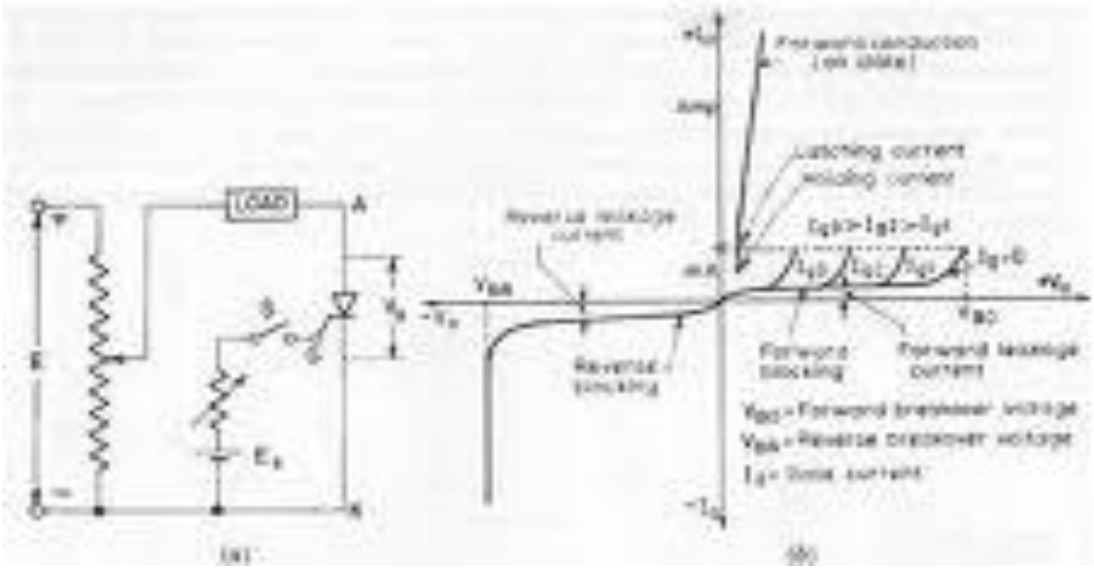
Ans: (2mark for characteristic, 2mark for explanation)

SCR is Four layer 3 terminal device which work in only in forward bias i.e. Anode positive and cathode negative with gate negative current, depending on I_G SCR can on and output can control. SCR is used in controlled Rectifier, It can used in chopper circuit, Speed control of DC Motor symbol is as shown in figure. Characteristics also as shown in figure.



V-I Characteristics of SCR

OR



iii) State the concept of online and offline UPS.

Ans: (2mark for off line,2mark for online ups)

Concept of ON line UPS

On Line UPS: UPS mean Uninterupted Power Supply .In on Line UPS Load always connected trough battery and Dc supply and Inverter.i.e.if main is on or off Load remain on and when mains is on,battery will be in charge and same time mains will give supply to load.This type of UPS is used in Computer and Device should not dissconnected as immediately

Concept of OFF line UPS

Off Line UPS: In this UPS When mains is on Supply is Directly Connected to Load.And battery charged parrallely.But mains is Off battery will take over Load trough inverter,and switch.When Mains is off ,Some time is required to take the load. This Type of UPs will Be used in Home Appliance.

Q.2 Attempt any four of the following: 16M

a) State the need of filters in regulated supply. State different types of filters. Draw the circuit of any one.

Ans: Need of filters: **1M**

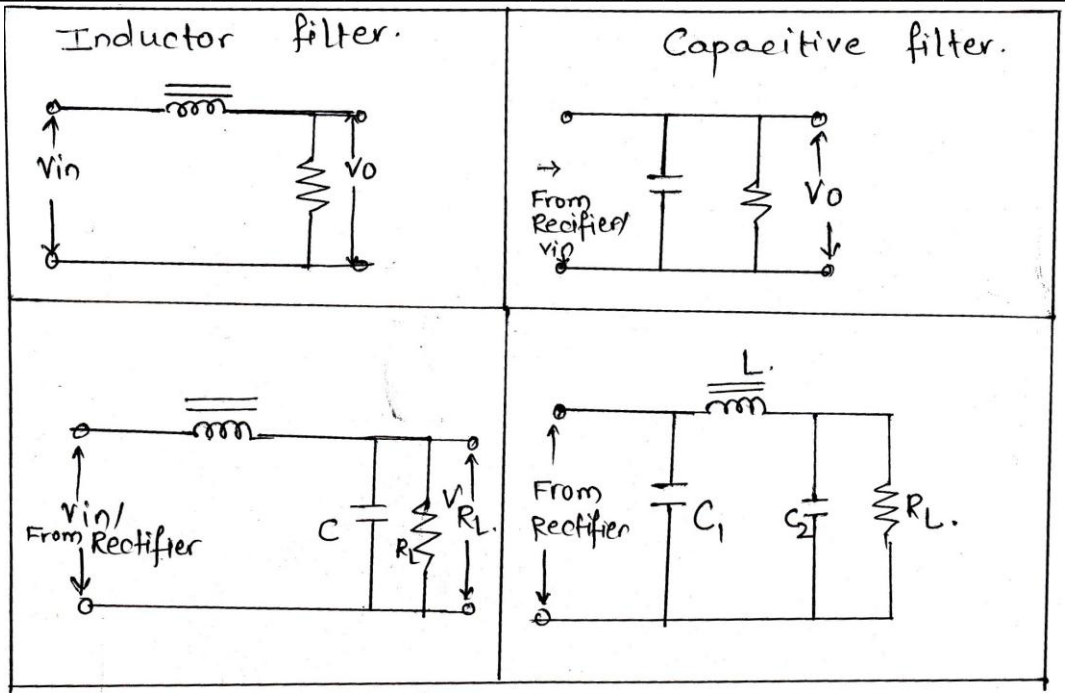
The output of rectifier or any converting circuit may contains dc component or ac component. The presence of ac component is undesirable in case of rectifier circuit. So it has to be removed from the rectifier output. This is done by filter circuit very easily.

Types of filters: **1M**

1. Inductor filter
2. Capacitor filter
3. Inductor- capacitor filter
4. Π filter

Diagram: **2M**

[Note: diagram any one of the following type]



b) Explain the working of Bridge Rectifier with a circuit diagram. Draw input and output waveforms.

Ans: Circuit Diagram: **2M**

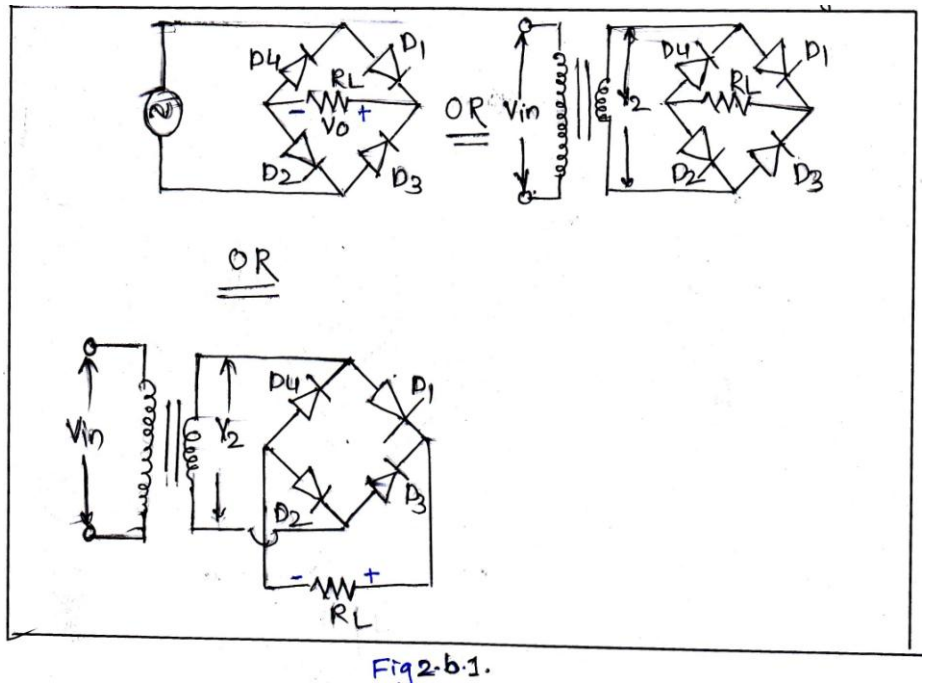
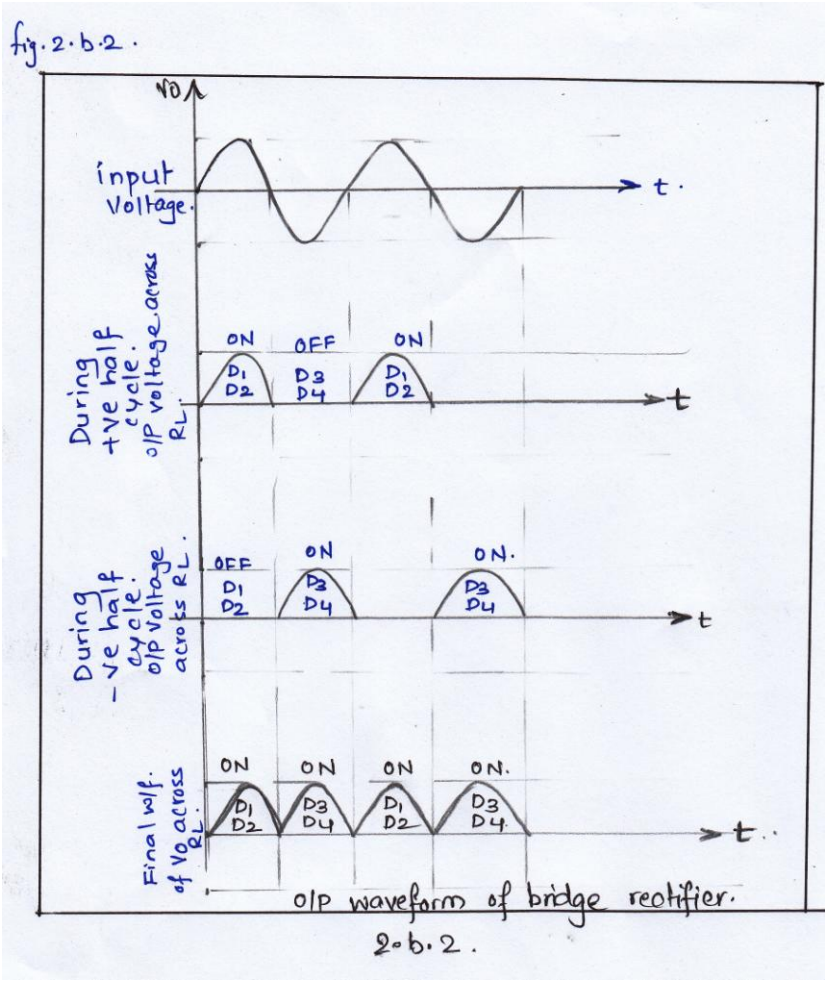


Fig 2-b-1.

Waveforms: **1M**



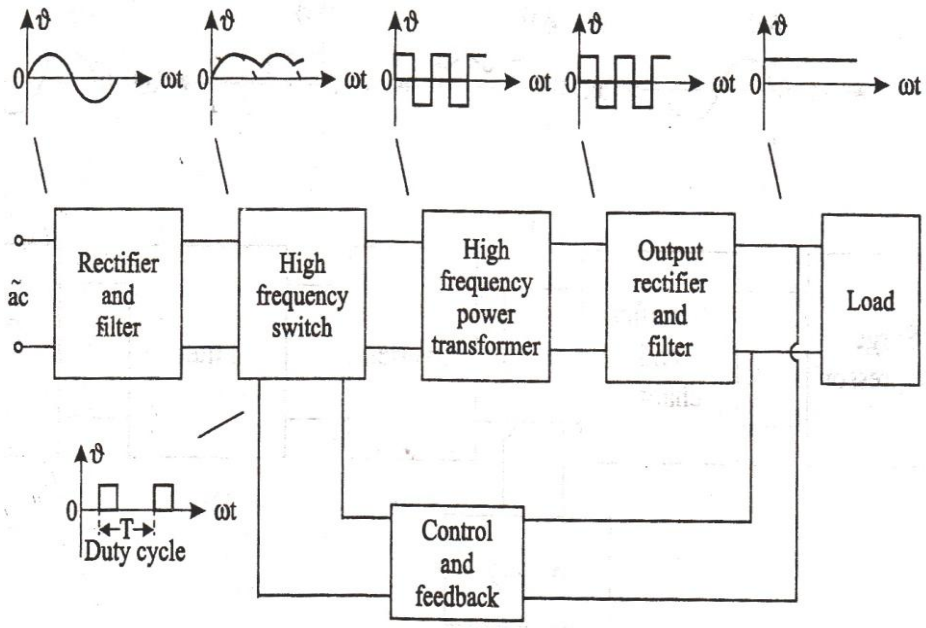
Working: 1**M**

It uses four diodes across input supply as shown in fig. 2.b.1.

1. When input voltage is positive as shown in fig. 2.b.2. the diodes D_1 and D_2 are forward bias and conduct the current. A voltage developed across R_L (like half wave rectifier). During this D_3 and D_4 are reversed biased.
2. When input voltage is negative diode D_3 and D4 are forward biased and conduct current through it. A voltage developed across RL with same direction, and same direction, and same polarity as shown in diagram. During this D1 and D2 are reversed biased.

c) Explain the working of SMPS with neat block diagram.

Ans: Block diagram of SMPS: **2M**



Working of SMPS as follows: **2M**

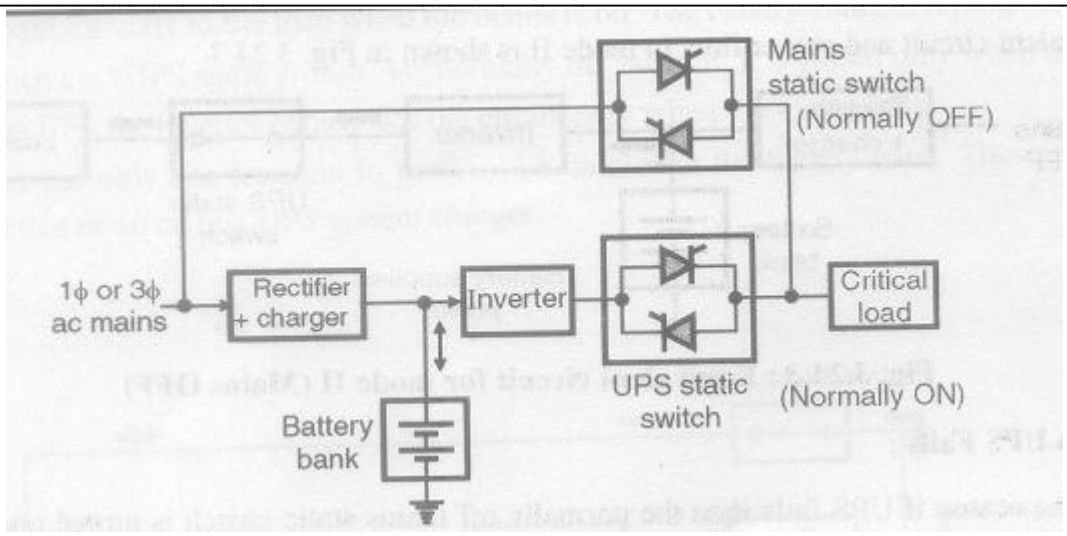
It consists of rectifier and filters, high frequency switch, high frequency power transformer, output rectifier and filter and control, and feedback section.

- Filter and rectifier first converts the AC supply voltage to DC where filters removes ripples from rectifier output. Here power diodes are used in rectifier section and capacitor filter.
- High frequency switching section converts DC voltage to a high frequency AC to a high frequency AC square wave by using MOSFETs or BJTs. High frequency ranges from 20KHz to 100KHz.
- This high frequency is applied high frequency power transformer that isolates the circuit and step-up or step-down the voltages as per requirement.
- The output of transformer is given to second rectifier section which handles high frequency input signals by using high frequency diode such as schottky diode and filter circuit of small capacitance capacitor.
- The last section of SMPS is control and feedback which provides a pulse width modulation output signal. It provides a duty-cycle that varies pulse by pulse to provide an accurate DC output voltage.

d) Draw the block diagram of on-line UPS and explain its working.

Ans: [Note: Another relevant diagram can be considered]

Diagram: **2M**



Explanation: **2M**

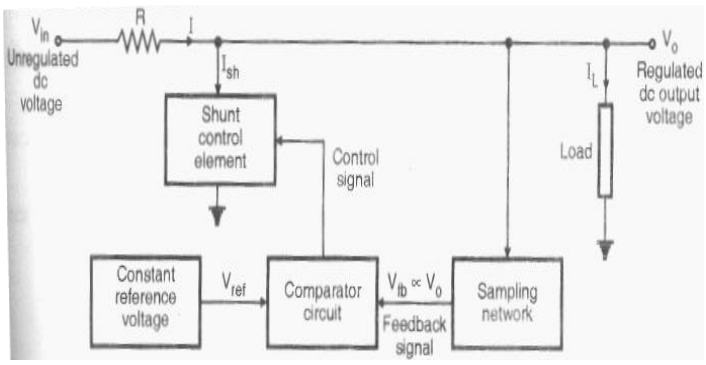
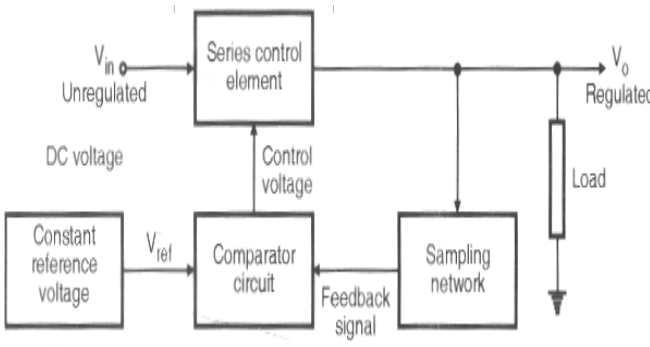
1) In the online UPS system the load is always connected to the inverter through the UPS static switch.
2) The UPS static switch is Normally ON switch. It turns off only when UPS system fails.
3) The Mains static switch is turned on to connect the ac mains directly to the load.
4) This switch is a Normally OFF switch and used only when UPS is to be bypassed.
5) When mains are off, battery bank supplier power to the inverter.
6) The inverter then drives the load through the UPS static switch.

e) Compare shunt and series voltage regulator with respect to

i) Block diagram

ii) Working

Ans: ***[Note: 2 mark for block diagram, 2 mark for working]***

Shunt Voltage Regulator	**Series Voltage Regulator**
Block diagram: 	Block diagram: 
Working:	Working:

Control element is in parallel with the load. o/p voltage is maintained constant by adjusting the current Ish through the control element.	Control element is in series with the load. o/p voltage is maintained constant by adjusting the voltage Vs across the control element

[Note: Any relevant point other than this explaining working of block diagram can be considered]

Q.3 Attempt any four of the following: 16M

a) Define Power Amplifier. List the types of Power Amplifiers.

Ans: ***[Note: 2 marks for definition. 2 marks for classification]***

Power amplifiers are large signal amplifiers. Whenever load demands a large power, specially designed amplifiers are used called power amplifiers. These amplifiers convert low power signal at their input to a high power amplifier.

Types of power amplifiers:

Class A

Class B

Class AB

Class C

b) State Barkhausen's criteria for obtaining sustained oscillations. List applications of oscillator.

Ans: ***[Note: 2 marks for condition of oscillations, 2 marks for applications]***

1) total phase shift in the loop is 360^0

2) Product of $A\beta >= 1$

Applications of oscillator:

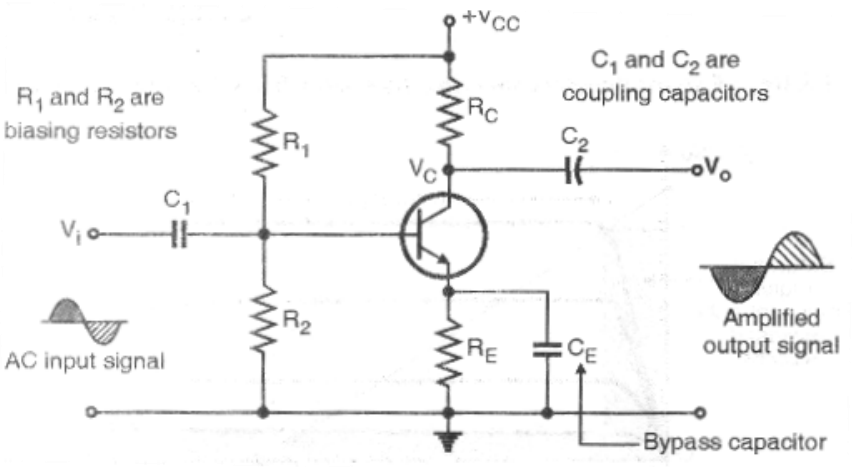
[Note: Any 2 applications]

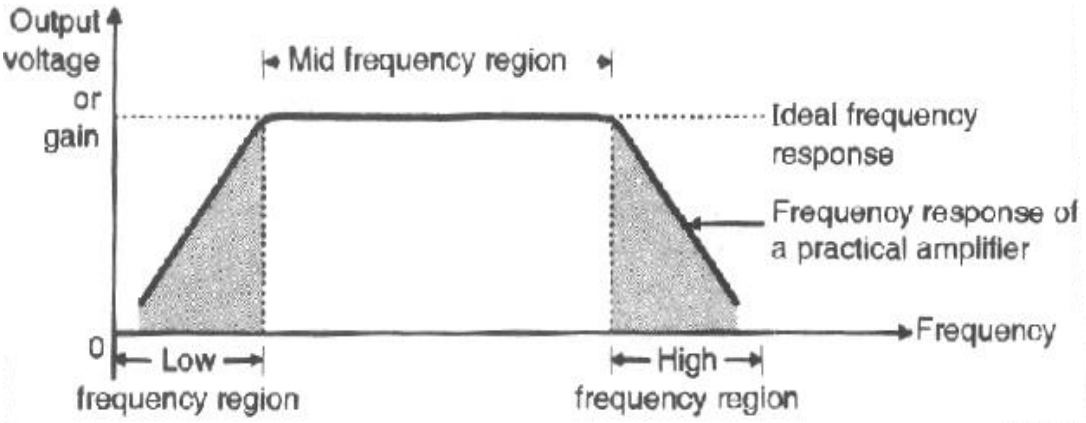
1) Used as local oscillators in radio, TV
2) In function generators.
3) Crystal oscillators in digital clocks.
4) In RF sources.
5) In frequency synthesizers.
6) As clock generation for logic circuits.
7) AM and FM transmitters.
8) Phase locked loops.

c) Explain single stage RC coupled amplifier with circuit diagram. Define frequency response.

Ans: ***[Note: 2 mark for diag., 1 mark for response, 1 marks for description]***

1) The capacitors C_1 and C_2 are called coupling capacitors.
2) As the load resistor RL is coupled to the amplifier through C_2 , it is called RC coupled amplifier.
3) R_1, R_2, RE are biasing resistors. C_E is the bypass capacitor.
4) RC is collector resistance.
5) The input signal is applied to the base of the transistor.
6) Transistor conducts and I_C flows.
7) Collector voltage also varies and o/p is coupled to the load through C_C
8) O/p magnitude is larger than the i/p.





d) With help of neat diagram explain working of RC phase shift oscillator.

Ans: ***[Note: 3 marks for diagram, 1 marks for explanation]***

1) It consists of a single stage amplifier.
2) As the amplifier is CE, it introduces 180 deg. Phase shift at the o/p

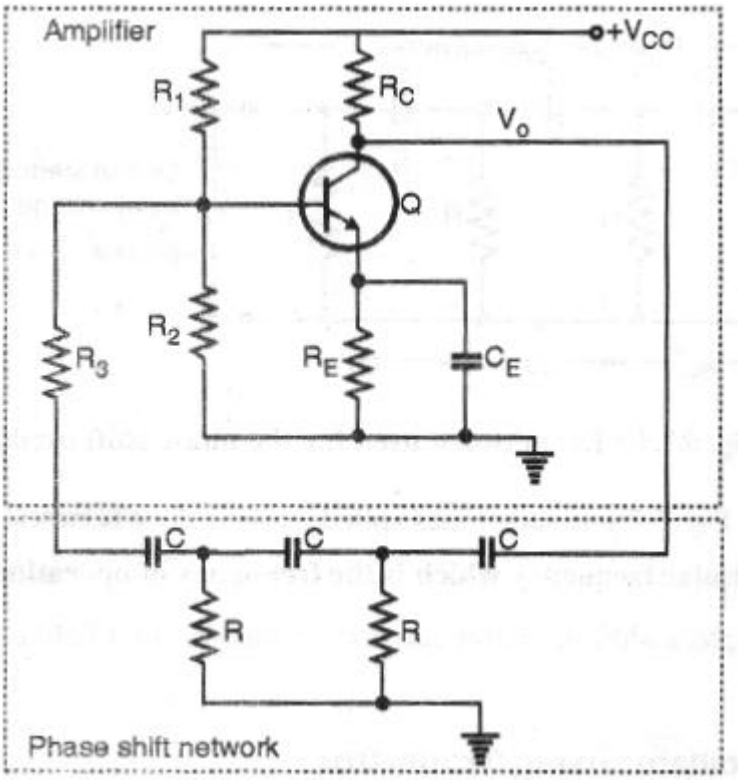
3) The phase shift of 3 RC networks will introduce 180^0 phase shift (each stage will introduce 60 deg phase shift each) and the total phase shift in the loop is 360 deg.

4) the product of AB >= 1 (loop gain) if adjusted properly, we will get sustains oscillations at the oscillator o/p.

5) Frequency of oscillations : $f=1/2\pi RC\sqrt{6}$

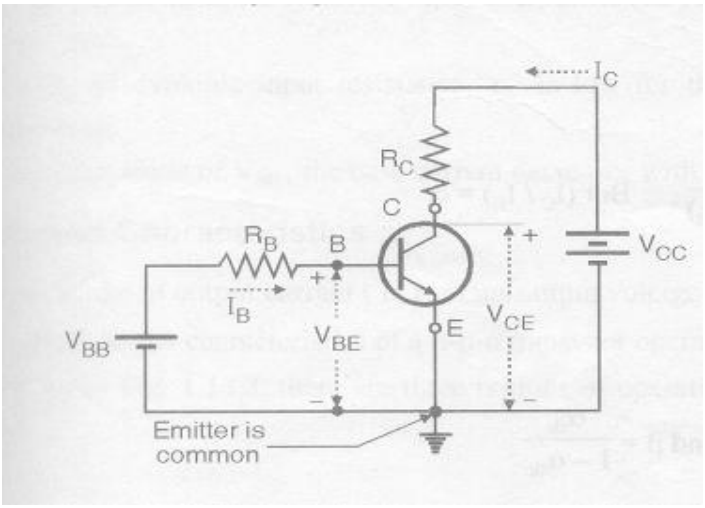
Where $R_1=R_2=R_3=R$

$C_1=C_2=C_3=C$



e) Draw neat circuit diagram of common emitter configuration and explain its working .

Ans: ***[Note: 2 marks for diagram, 2 marks for Description]***



1) Emitter acts as a common terminal between i/p and o/p.
2) Base emitter is forward biased and base collector is reverse biased.
3) V_{CE} is the output voltage and I_C is the output current.
4) Current gain of CE configuration is : $\beta = I_C/I_B$

f) Compare between CC, CE and CB configuration.

Ans: ***[Note: Any four points 4 marks]***

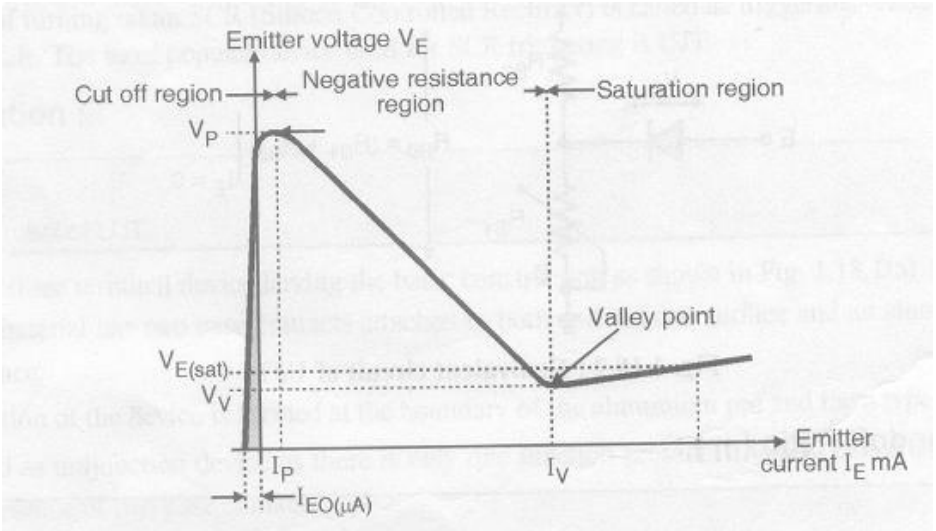
Parameter	**CB**	**CE**	**CC**
Common terminal	Base	Emitter	Collector
Input terminal	Emitter	Base	Base
Output terminal	Collector	Collector	Emitter
Current gain	Ic/IE	Ic/IB	IE/IB
Voltage gain	High	High	Less than 1
Input resistance	Medium	Low	High
Output resistance	Medium	High	low
Applications	High frequency amp	Audio amplifier	Buffer amplifier

Q4) Attempt any four of the following: 16M

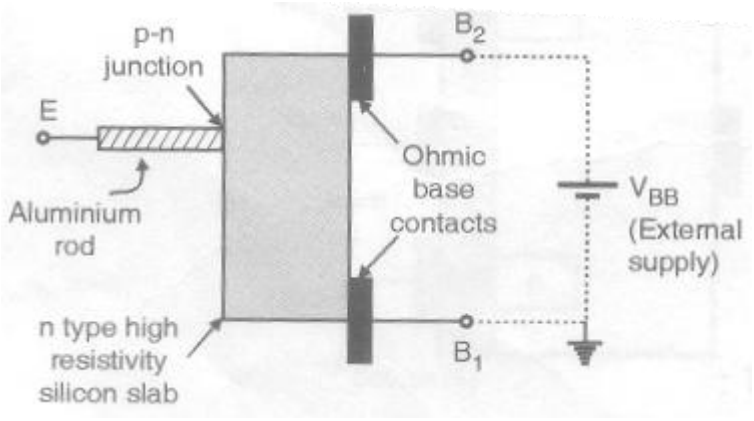
a) Draw construction and symbol of UJT. Draw characteristics.

Ans: ***[Note: 1 mark for construction, 1 mark for symbol, 2 marks for characteristics]***

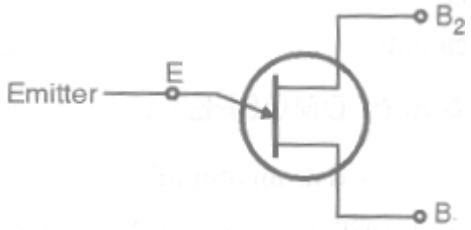
Characteristics:



Construction:

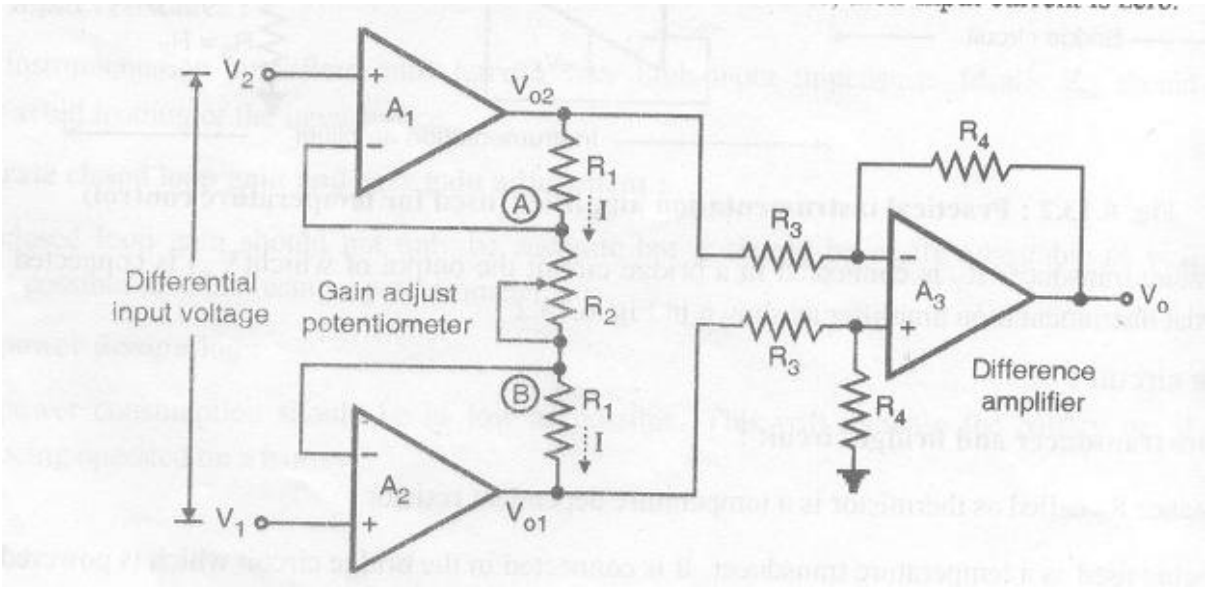


Symbol:



b) Explain the working of instrumentation amplifier using 3 op-amp with neat circuit diagram.

Ans: ***[Note: 3 marks for diagram, 1 marks for description]***



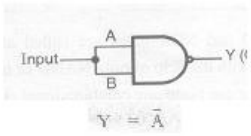
1) It is a high impedance amplifier.
2) A1 and A2 are non inverting amplifiers, the second stage op-amp is a difference amplifier.
3) By using a variable resistor R2 overall gain can be easily adjusted and linearly varied.

4) O/p voltage = Av(V1-V2)

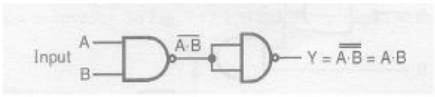
c) Why NAND and NOR gates are called universal gates.

Ans: ***[Note: 2 marks for reason, 2 marks for any two gates built by NAND or NOR gates.]***

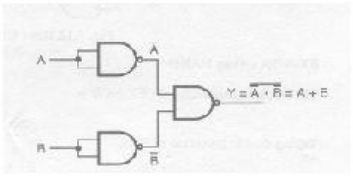
NAND and NOR gates are called as universal gates because it is possible to implement any Boolean expression with the help of only NAND and NOR gates.



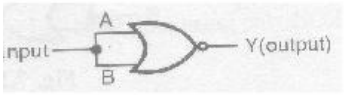
NAND as NOT gate



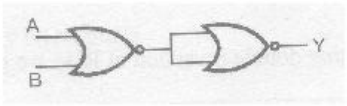
NAND as AND gate



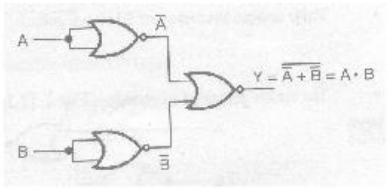
NAND as OR gate



NOR as NOT gate



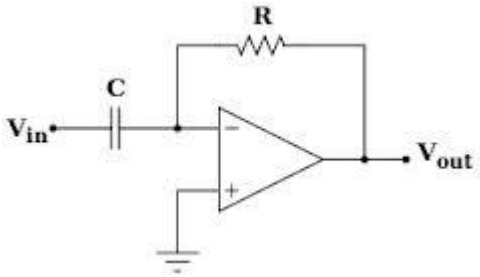
NOR as OR gate



NOR as AND gate

d) Explain the working of differentiator using Op AMP with neat circuit diagram.

Ans: ***[Note: 2 mark for diagram and 2 mark for explanation]***



1) A differentiator circuit consists of an operational amplifier, resistors are used at feedback side and capacitors are used at the input side. The circuit is based on the capacitor's current to voltage relationship
2) I=C dV/dt
3) where I is the current through the capacitor, C is the capacitance of the capacitor, and V is the voltage across the capacitor. The current flowing through the capacitor is then proportional to the derivative of the voltage across the capacitor.
4) V_0= -RC dV_{in}/d_t

5) Output is proportional to the time derivative of the input – Hence, the op amp acts as a differentiator; The minus sign indicates the phase difference of 180 degrees between the output and the input.

e) Compare Non-inverting and inverting amplifier by op-amp for fall points.

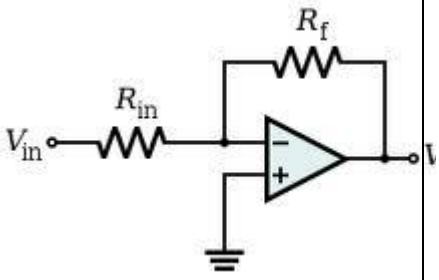
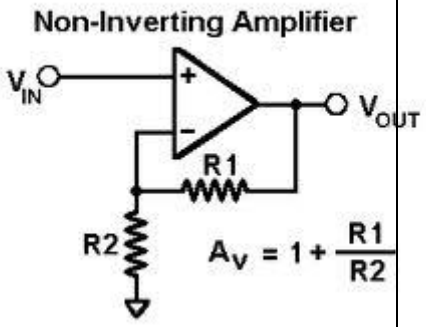
i) Circuit diagram

ii) Gain

iii) o/p expression

iv) application.

Ans: ***[Note: 4 points-4 marks]***

parameter	Inverting	Non inverting
circuit		
Gain	Avf= -Rf/R1	Avf=1+Rf/R1
o/p expression	Vo=Avf*Vin	Vo=Avf*vin
Application	Adder, subtractor, to introduce phase shift	Buffer amplifier

f) Explain the working of PTC and NTC thermistor.

Ans: ***[Note: 2 marks for PTC and 2 marks for NTC]***

NTC-negative temperature coefficient thermistors

Its resistance decreases with increases in temperature. They can be used to measure temperature in range -100 C to 320^0 C

PTC – positive temperature coefficient thermistors

Its resistance increases with increase in temperature.

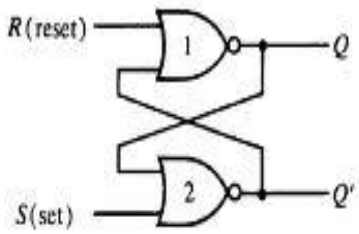
They can be used to measure temperature in range -400^0 C to 1000^0 C.

Q.5 Attempt any four of the following: 16M

a) Draw the logical symbol of RS Flip Flop and write its truth table.

Ans: (2 mark for Diagram And 2 mark for truth table)

RS FLIP-FLOP Symbol:

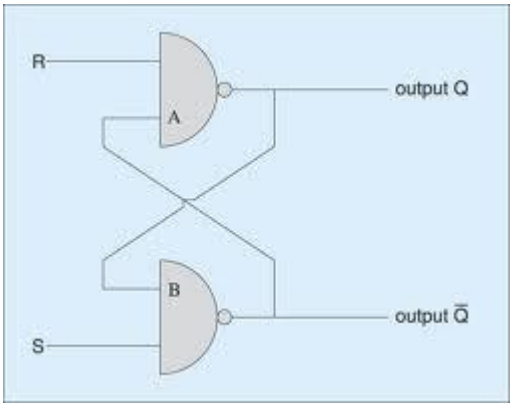


(a) Logic diagram

S	R	Q	Q'	
1	0	1	0	
0	0	1	0	(after $S = 1, R = 0$)
0	1	0	1	
0	0	0	1	(after $S = 0, R = 1$)
1	1	0	0	

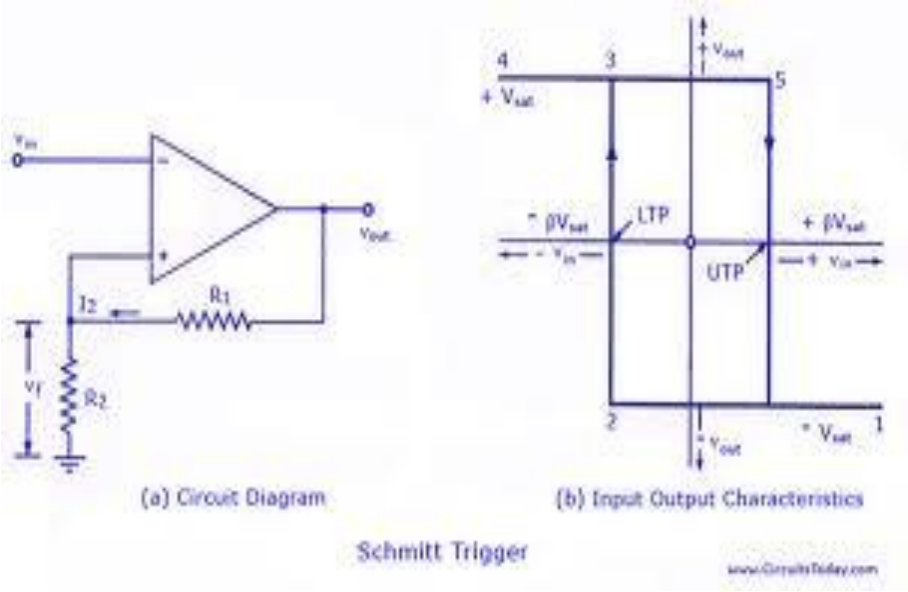
(b) Truth table

OR

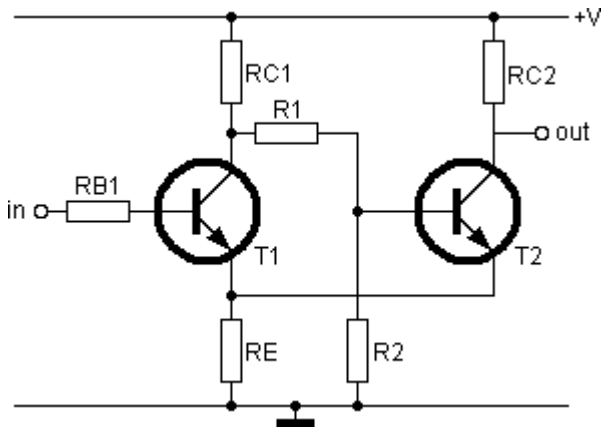


b) Describe operation of Schmitt trigger.

Ans: (2 mark for any diagram, 2 mark for exaplanation)



OR

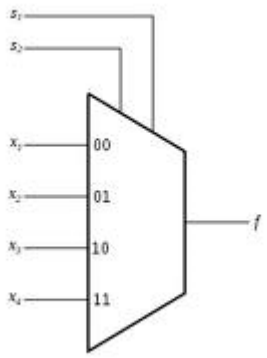


Schmitt Trigger can be used as wave shaping circuit.This circuit can be used to convert any wave to square wave. a Schmitt trigger is a circuit with positive feedback and a loop gain greater than 1. The circuit is named a "trigger" because the output retains its value until the input changes sufficiently to trigger a change. In the non-inverting configuration, when the input is higher than a certain chosen threshold, the output is high. When the input is below a different (lower) chosen threshold, the output is low, and when the input is between the two levels, the output retains its value. This dual threshold action is called hysteresis.

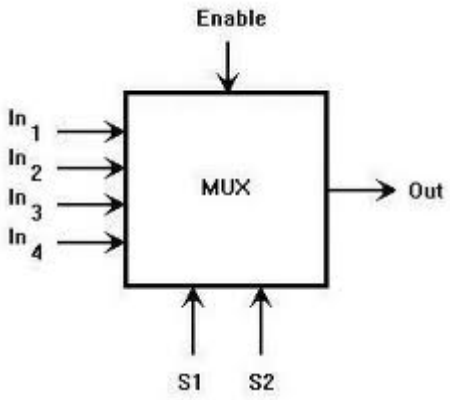
[Note: this explanation can be other word,any logical explanation can be consider.]

c) Draw the logical symbol of 4:1 Mux. Write its truth-table and the expression for output.

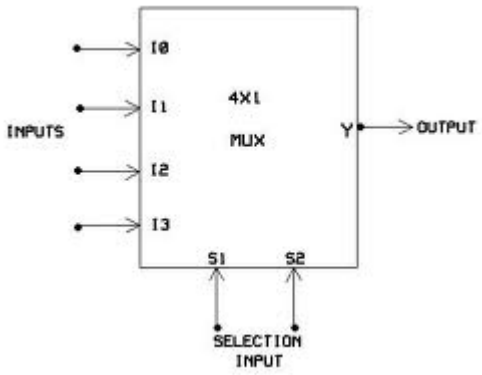
Ans: ***[Note: Schematic diagram for 2 mark (any one diagram), 2 mark for truth table]***



OR



OR



Truth Table:

DATA-SELECT INPUTS S_1	S_0	INPUT SELECTED
0	0	D_0
0	1	D_1
1	0	D_2
1	1	D_3

d) Convert the following decimal numbers to binary

i) 10101

ii) 217.625

Ans: 10101= 10101

[Note: for above numberStudent can consider no as Decimal number and they can solve.]

217.625(10)=11011001.101

[Note: for step mark should be given if anwser is wrong]

e) Design 3-bit SISO shift register and explain its waveform with n-waveforms.

Ans: (waveform 2 mark, 2mark for Diagram)

[Note: Explanation may not require]

Waveform:

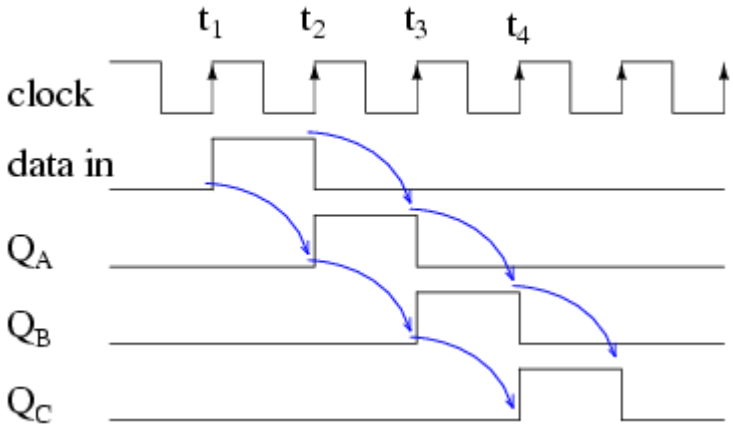
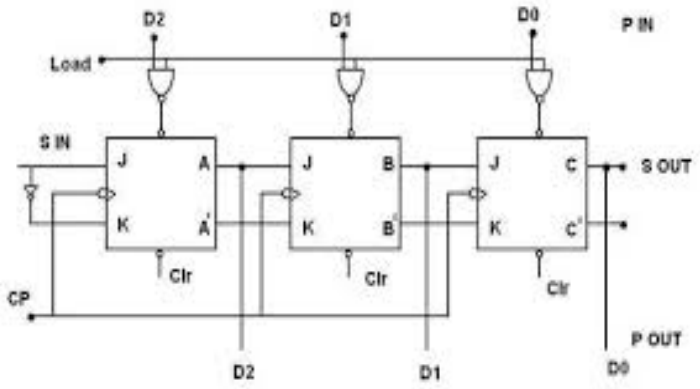
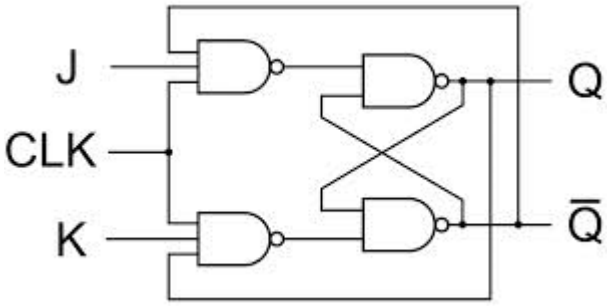


Diagram:



f) Explain the working of JK Flip-Flop with the help of diagram using NAND Gates and Truth-table.

Ans: *[Note: Explanation may not require]*



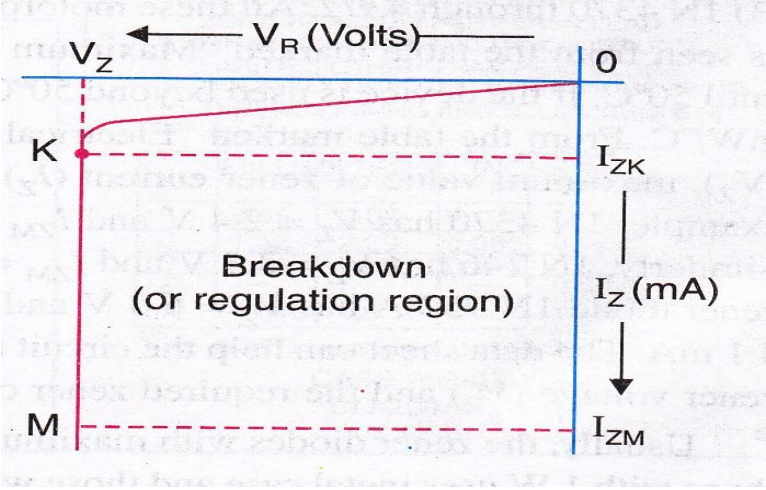
Truth Table

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

Q.6 Attempt ant four of the following: 16M

a) Explain the working of zener diode with the help of V-I characteristics.

Ans: Characteristics of zener diode: **2M**



Explanation: **2M**

Zener diode maintains a constant voltage across it so long as it is operated in the reverse breakdown region and the input voltage does not fall below the zener voltage (V_Z).

As the load current (I_L) increases, the zener current (I_Z) decreases so that current through resistor R_S. remain same. The characteristics shown when reverse voltage is increased, the reverse current initially remains negligibly small upto knee point (k). at this point the effect of breakdown process begins. From the bottom of the knee, the breakdown voltage remains constant. This voltage is termed as zener breakdown voltage is termed as zener breakdown voltage and this ability is called regulating ability.

b) Compare Mono-stable and Astable multivibrator.

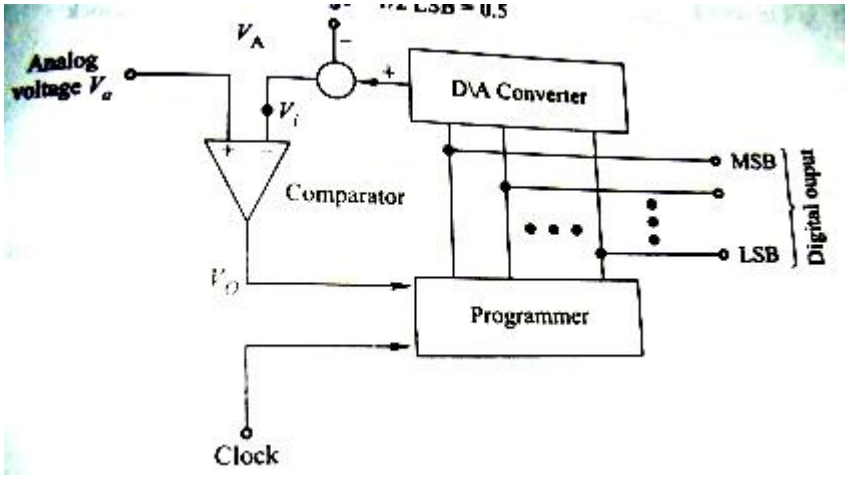
Ans: ***[Note: Any 4 points- 4 marks, any other relevant point can be considered]***

Astable Multivibrator	**Mono-Stable Multivibrator**
Free running relaxation oscillator.	One-shot univibrator.
It can generate square waveform, rectangular wave.	Generate gating pulse.
Two quazistable states (ON and OFF)	It has only one quazistable state.
It does not require trigger pulse.	It requires external trigger pulse.
Time duration for the waveform, $T = T_{ON} + T_{OFF}$. Where $T_{ON} = 0.69 * (R_A + R_B)C$	Time duration for pulse, $T_P = 1.1\ R_1 * C_1$

$T_{OFF} = 0.693 * (R_B*C)$	
$T_{ON} = T_{OFF}$	$T_{ON} \neq T_{OFF}$

c) Explain the working ADC of successive Approximation method with the help of neat diagram.

Ans: Successive approximation method of ADC Diagram: **2M**

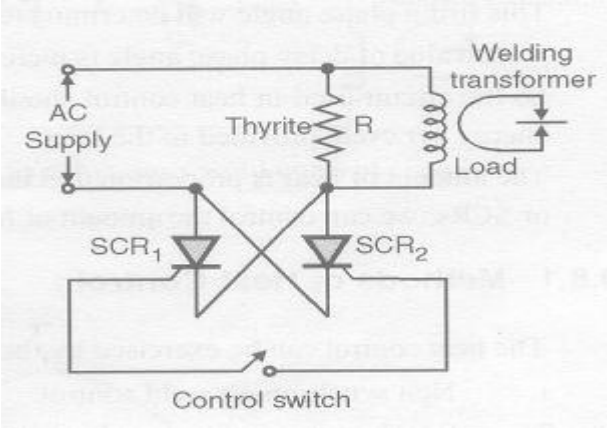


Working: **2M**

The comparator serves the function of the scale, the output which is used for setting/resetting the bit at the output of the programmer. This output is converted into equivalent analog voltage from which the offset voltage is subtracted & then applied to the inverting input terminal of the comparator. It should be noted that the offset weight was added on the side of unknown weight & therefore, it is to be subtracted from the known weight side for getting the equivalent effect. The outputs of the programmer will change only when the clock pulse is present. To start conversion, the programmer sets the MSB to 1 & all other bits to 0. This is converted into analog signal by D/A converter & comparator compares it with the analog i/p voltage. If the analog i/p voltage Va≥Vi, the o/p voltage Vo of the comparator is high which sets the next bit also. On the other hand if Va<Vi then Vo is low which resets the MSB & sets the next bit. Thus, a 1 is tried in each bit of D/A converter until the binary equivalent of analog i/p voltage is obtained.

d) Explain the working of temperature control circuit using SCR.

Ans: Diagram: **2M**



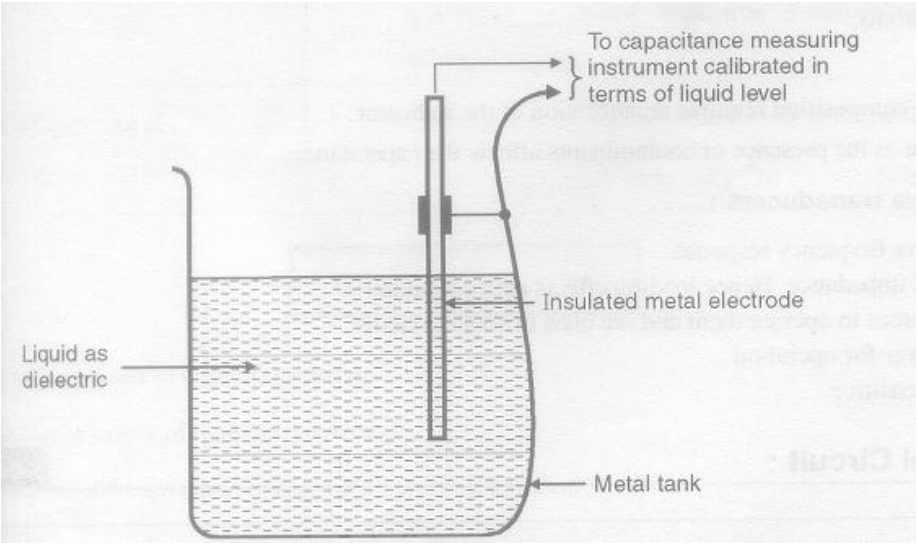
Explanation: **2M**

1) The quality of weld depends on two factors magnitude of welding current and the duration for which it flows through the welding transformer.
2) Heat control circuit will decide the firing angle of ignitron or SCR in each half cycle of line voltage.
3) The circuit used in heat control should be capable to vary the delay phase angle gradually. It controls the welding energy per cycle provided to the load.
4) The amount of heat is proportional to the square of welding current. Hence by varying the firing angle of the ignitron or SCR, we can control the amount of heat produced precisely.

e) Explain the working of Level Control Circuit using variable capacitor and potentiometer.

Ans: Diagram: **2M**

Level measurement circuit using VARIABLE CAPACITANCE AND POTENTIOMETER



Explanation: **2M**

The electrical capacitance of the sensing probe varies with the level of material and hence level changes can be recorded in terms of the electrical capacitance of the probe i.e. higher the liquid level greater is the capacitance.

The arrangement is similar to that of parallel plate condenser where dielectric is used as medium to separate two conductors.

The capacitance of the capacitor depends on the height of dielectric between the plates. The greater the height, greater is the capacitance The capacitance is proportional to the height of the liquid in the tank.

f) Compare class A and class B power amplifiers for

i) Operating point

ii) Conduction cycle

iii) Efficiency

iv) Application

Ans: ***[Note: Each point 1 mark]***

Parameter	**Class A power amplifier**	**Class B power amplifier**
Operating point	At a center of load line.	At cut-off region.
Conduction cycle	Full cycle	Half cycle
Efficiency	Efficiency is less than class B. 25%.	Overall efficiency 50-70%. i.e. more.
Application	Used as pre-amplifier, audio amplifier.	In public address system tape recorder stereo amplifier.