MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

Summer 2016– EXAMINATIONS

Subject Code: **17541** **Model Answer**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the 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 judgment 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.

Q1. A) Attempt any three: (12 mks)

a) State the need of protection circuits for power devices. List different types of protection circuits.

Ans :(Need of protection circuits 2M, types 2M)

Need:

- To provide protection against over voltage, over current, di/dt, dV/dt, and over temperature.
- In the converter circuit voltage transient get generated due to reverse recovery process of the power devices and switching take place in presence of supply and load inductance.
- The short circuit fault condition or the cross conduction taking place in convertor circuit will result in heavy fault current flowing through the devices. So we require protection circuit.

Different protection circuits: 2 marks

- Fuse and circuit breakers
- Crowbar circuit
- di/dt protection and dv/dt protection provided by snubber circuit
- Selenium diode
- MOV

b) What are the types of choppers? Draw the basic circuit of step down chopper and describe its operation in brief.

Ans: Choppers are classified: (1 mks) (any one classification)

On the basis of Input/output Voltage Levels:

1) Step Up Chopper
2) Step Down Chopper

On the basis of Quadrant operation:

1) Class A [First-quadrant Operation]
2) Class B [Second-quadrant Operation]
3) Class C [Two-quadrant type A Operation]
4) Class D [Two-quadrant type B Operation]
5) Class E [Four-quadrant Operation]

On the basis of commutation

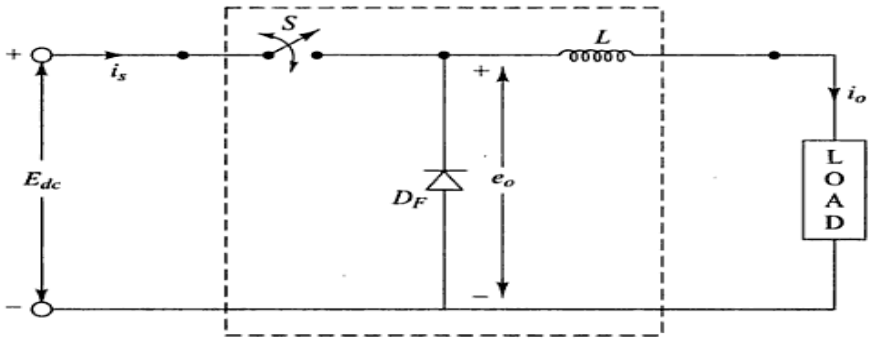
1) Voltage commutated
2) Current commutated

Operation: (1 mks)

- When CH is turned ON, Vs directly appears across the load as shown in figure. So VO = VS.

- When CH is turned off, Vs is disconnected from the load. So output voltage VO = 0.

Circuit Diagram: (2 mks)(give marks for any basic diagram with R load also)



Basic chopper circuit

c) State the types of inverters. Draw the circuit of current source inverter and describe its operation in brief.

Ans: Classification (1 mks):(ANY TWO TYPES)

Based on configuration:

1. Series inverter
2. Parallel or push-pull inverter
3. Bridge inverter.
   i. Half Bridge inverter.
   ii. Full Bridge inverter.

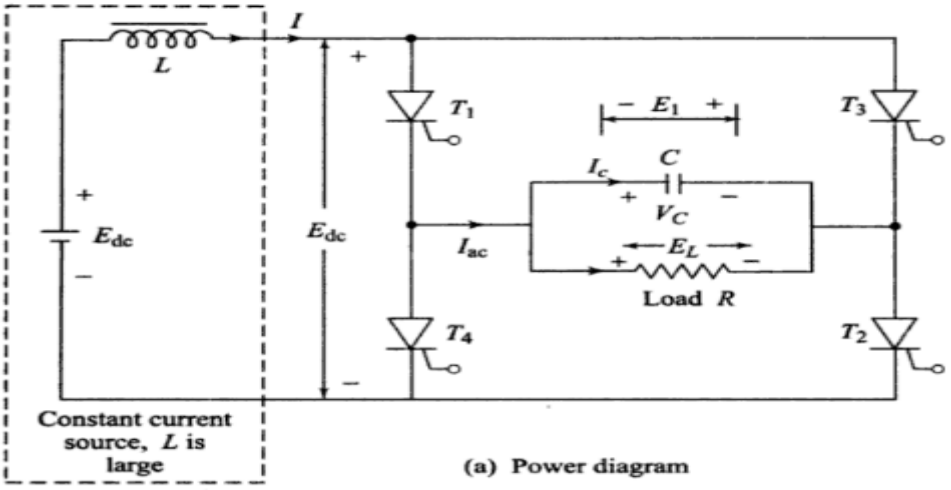
Based on commutation circuits:

1. Line Commutated Inverters.
2. Forced Commutated Inverters.
   i. Auxillary Commutated Inverters.
   ii. Complementry Commutated Inverters

Based on o/p waveform

1) Square wave
2) Sinewave
3) Quasi squarewave
4) PWM

Circuit Diagram (1 ½ mks):

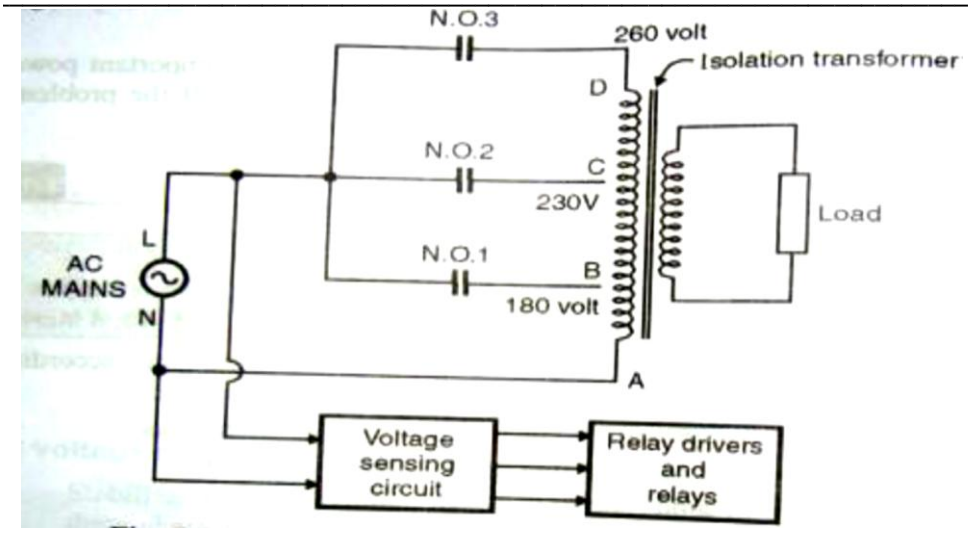


(a) Power diagram

Working (1 1/2) mks):

- Before t = 0, let the capacitor voltage be Vc = - E1 , i.e capacitor has right plate positive and left plate negative.
- At t = 0, T1 and T2 are triggered, and when T1 and T2 turn on, capacitor applies reverse voltage across the previously conducting thyristors T3 and T4 , hence turning them off.
- The source current I now flows through T1, parallel combination of R, C and T2.
- From 0 to T/2, IT1 = I T2 = I, output current Iac = I,capacitor voltage Vc changes from - E1 to + E1 through the charging of C by current Ic .
- Hence load voltage EL = Vc.
- When T3,T4 gated at T/2, Vc = E1 reverse biases T1,T2; these are therefore turned off immediately.
- The source current I now flows through T3, parallel combination of R, C and T4.
- From T/2 to T, IT3 = I T4 = I, output current Iac = - I.

d) Describe the working of relay type AC voltage stabilizer with suitable diagram.
Ans: Circuit Diagram (2 mks):

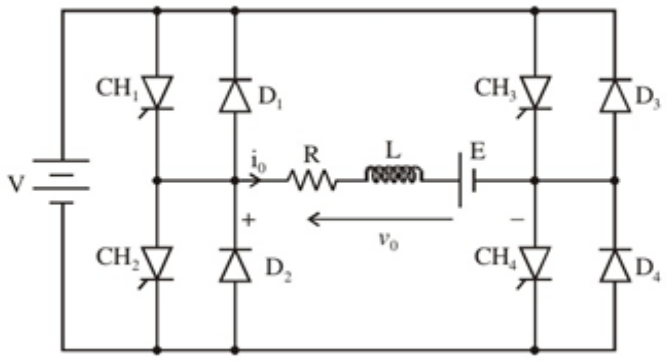


Working (2 mks):

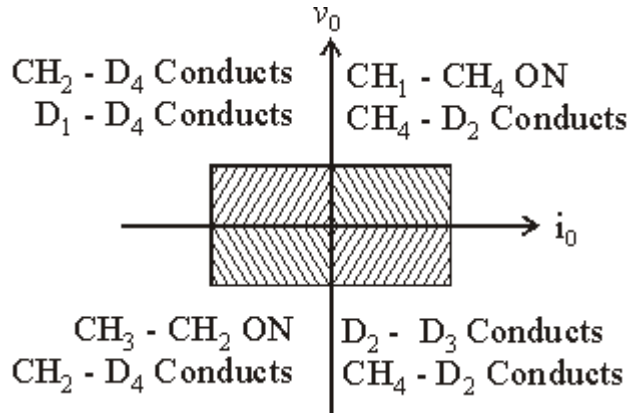
- The primary winding is divided into several taps.
- End A of transformer is connected to neutral.
- The line terminals B, C, D are connected to the taps through the normally open contacts of the relay. The transformer works as step up, step down or isolation transformer.
- The voltage sensing circuit senses the input voltage and the relay driver circuit operates the relay.
- If there is an over voltage, say 260 V, NO3 will be closed and the output voltage will be reduced.
- If there is an under voltage, say 180 V, NO1 will be closed and the output voltage will be increased.
- Output is discontinuous control type and not suitable for critical load.

Q1. B) Attempt any one: (6 mks)

a) Describe with circuit diagram how chopper can be operated in four quadrants.
Ans: Circuit Diagram (3 mks): Class E chopper



Quadrant Diagram (Optional) :



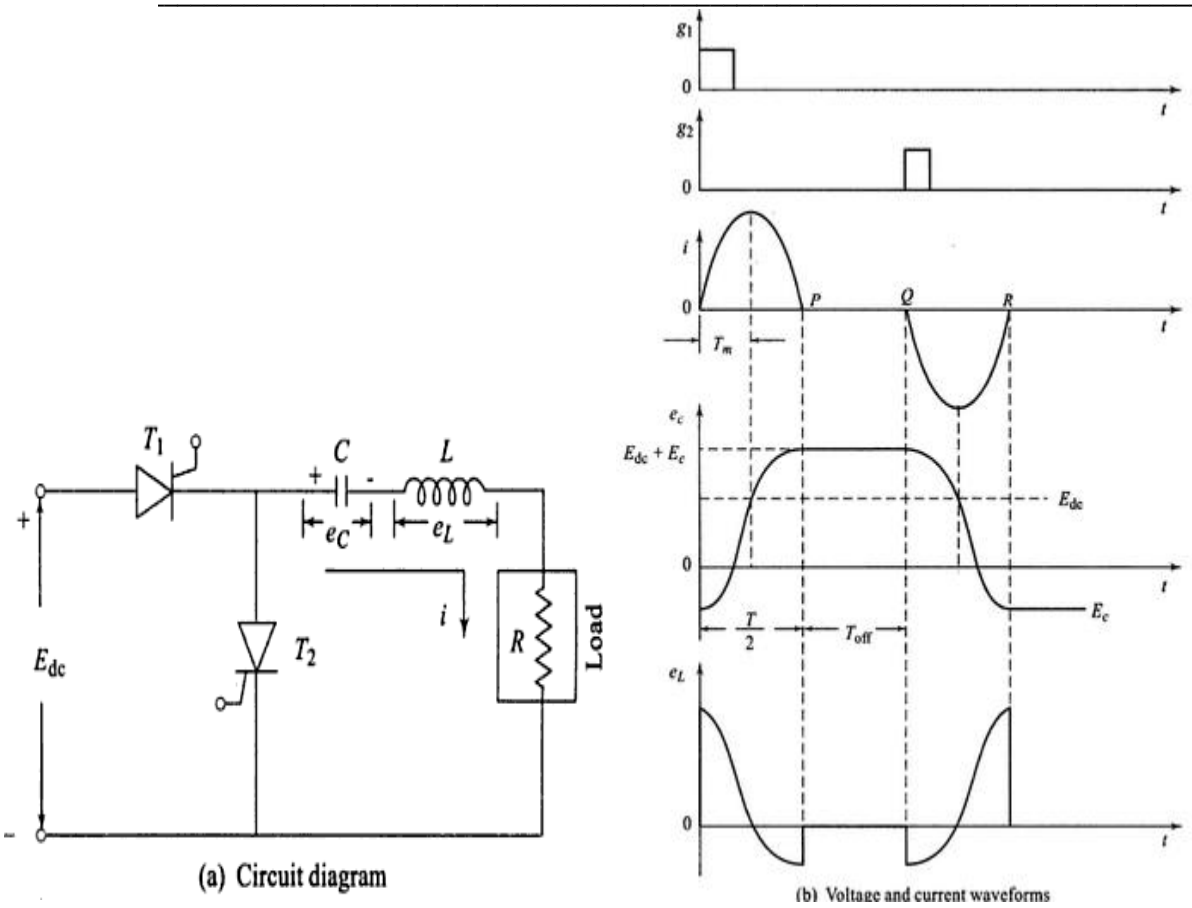
Working (3 mks):

- Class E is a four quadrant chopper.
- When CH1 and CH4 are triggered, output current io flows in positive direction through CH1 and CH4, and with output voltage Vo = V.
  This gives the first quadrant operation.

- When both CH1 and CH4 are OFF, the energy stored in the inductor L drives io through D2 and D3 in the same direction, but output voltage Vo = -V. Therefore the chopper operates in the fourth quadrant.
- When CH2 and CH3 are triggered, the load current io flows in opposite direction & output voltage Vo = -V. Since both io and Vo are negative, the chopper operates in third quadrant.
- When both CH2 and CH3 are OFF, the load current io continues to flow in the same direction D1 and D4 and the output voltage Vo = V.
  Therefore the chopper operates in second quadrant as Vo is positive but io is negative.

b) Describe the working of series inverter with neat circuit diagram and waveforms.

Ans: Circuit Diagram (2 mks) and Waveforms (2 mks) :



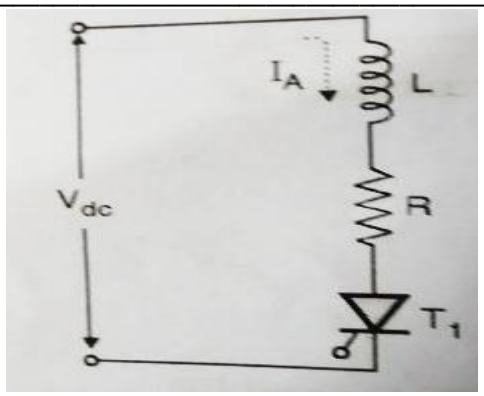
Working (2 mks):

- When S1 (T1) is triggered the capacitor starts charging with left plate positive with respect to right and when the voltage on capacitor is slightly greater than Edc then T1 turns off; but there is no discharge path for capacitor hence it holds the charge.
- When trigger pulse is applied to T2, then T2 start conducting so current starts flowing in opposite direction.
- In this way due to charge and discharge of capacitor and switching of T1 and T2 current will flow in RC.
- Hence sinusoidal current starts flowing in the load.

Q2. Attempt any two: (16 mks)

a) Draw di/dt protection circuit and describe its operation.

Ans: Circuit Diagram (4 mks):



Working (4 mks) :

Effect of High Current Rise Rate :

- di/dt is the rate of change of current in a device.
- When SCR is forward biased and is turned ON by the gate signal, the anode current flows.
- The anode current requires some time to spread inside the device. (Spreading of charge carriers).
- But if the rate of rise of anode current (di/dt) is greater than the spread velocity of charge carriers then local hot spots is created near the gate due to increased current density. This localized heating may damage the device.
- Local spot heating is avoided by ensuring that the conduction spreads to the whole area very rapidly. (OR) The di/dt value must be maintained below a threshold (limiting) value.

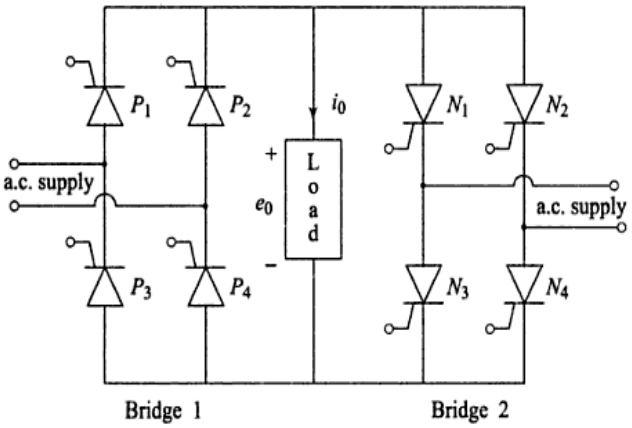
Protection Method :

- This is done by means of connecting an inductor in series with the thyristor.
- The inductance L opposes the high di/dt variations.
- When the current variation is high, the inductor smooths it and protects the SCR from damage. (Though di/dt variation is high, the inductor 'L' smooths it because it takes some time to charge). $L \geq [Vs / (di/dt)]$.

b) Describe the operation of single phase cycloconverter with suitable diagram and waveforms.

Ans:

Circuit Diagram (3 mks): **(give marks for any type of single phase cyclo converter with waveform of any frequency & working)**



Bridge configuration single phase cycloconverter

Waveforms (3 mks) :

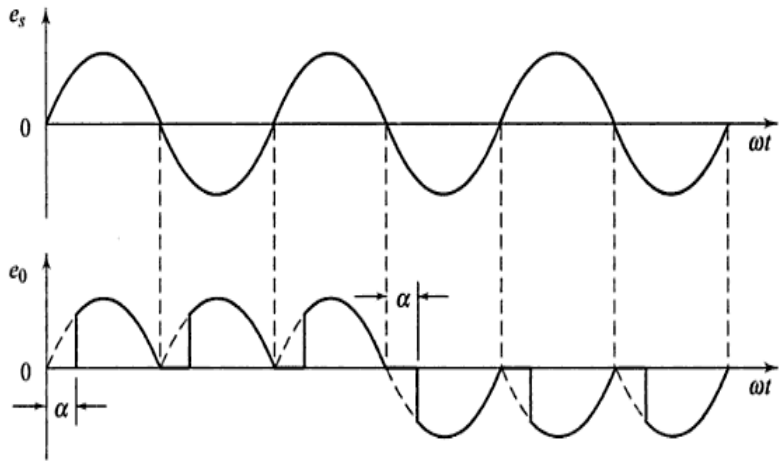


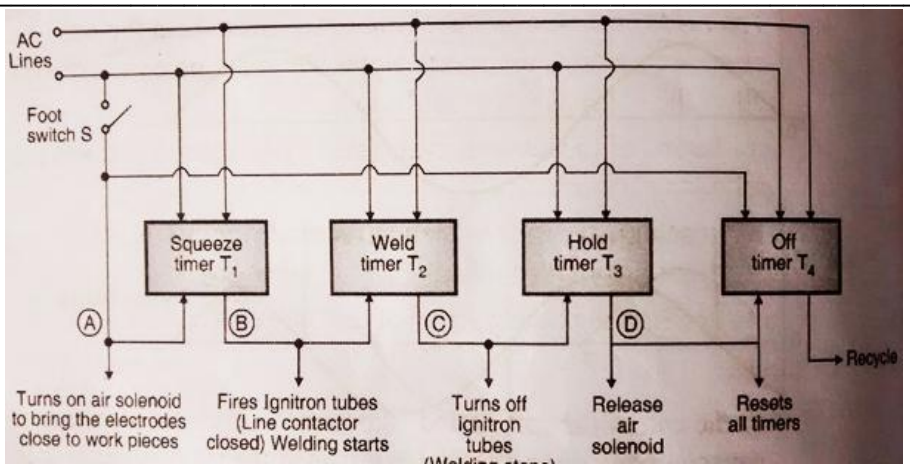
Fig. 10.4 *Input and output waveforms of a $16\frac{2}{3}$ Hz cycloconverter (pure resistance load)*

Explanation (2 mks) :

- CycloConverter reduces the input frequency.
- Depending upon firing sequence of the SCRs that particular SCR conducts.
- For example, in the diagram shown, SCRs firing sequence is P1, P2, P1. This forms the single positive half cycle.
- For the negative half cycle, firing sequence is NI, N2, N1.
- The output frequency is reduced to 1/3.

c) Draw Block diagram of sequential timer for resistance welding. Describe the function of each block.

Ans: Circuit Diagram (4 mks);



Operation (4 mks):

1. **Squeeze timer:**
   - In Fig., S indicates the operator's foot switch, to initiate the operation. The operator first locates the work properly and then presses the foot switch S.
   - This turns on the air solenoid valve to the cylinder that forces the welding electrodes together and activates the squeeze timer T_1 through line A.
   - After a predetermined squeeze time, timer T_1 operates to initiate the welding current.
2. **Weld Timer:**
   - At the end of predetermined squeeze time, timer T_1 operates to initiate the welding current by turning on the ignitrons and simultaneously starts the "Weld timer" T_2 through line B.
   - At the end of the weld interval, timer T_2 operates to turn off the ignitron switch and simultaneously start the timing action of "Hold timer" T_3.
3. **Hold Timer:**
   - The hold timer will produce control signals to hold the welding electrodes against the metal pieces for some time, in order to allow the metal pieces to cool down.
   - At the end of the hold interval, timer T_3 operates to perform the following operation:
     1) Release the air solenoid to separate the electrodes.
     2) Reset all the timers.
     3) Start the timing action of the "off timer" T_4.
4. **Off Timer:**
   - At the end of the off interval, timer T_4 operates to initiate a new complete timing sequence provided the operator continues to press the foot switch S.
   - The off period is utilized by the operator to shift the work to a new spot.
   - Since the switch S is foot operated the operator has his hands free to move the work during the "off interval" between successive welds.

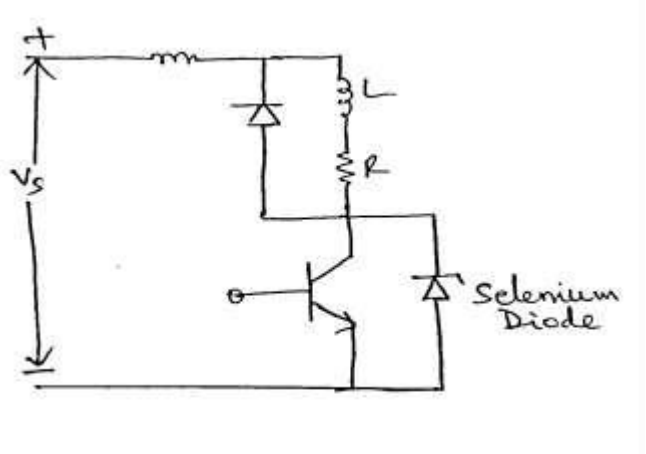
- By proper design of the timer circuits, it is possible to select any desired value for each of the four time intervals.

Q3. Attempt any four: **16**

a) Describe how SCR can be protected from overvoltage with neat circuit diagram.

Ans: Circuit diagram: 2Marks

Using Selenium diodes:

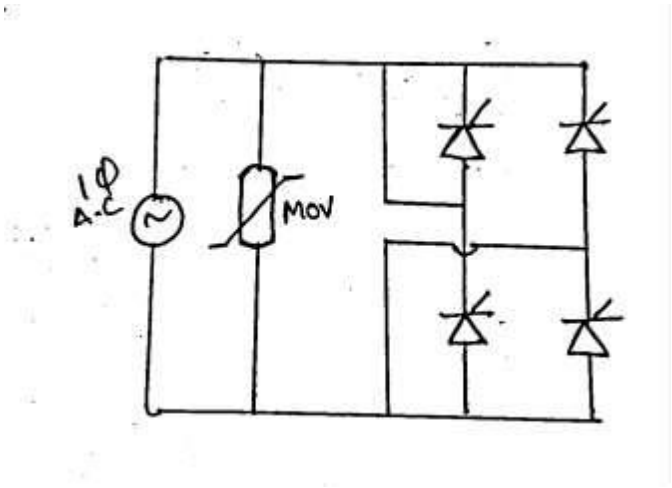


Explanation: 2 Marks

Selenium diodes are used for suppressing overvoltage. It is connected across the device to be protected. In case of an over-voltage it conducts and clamps this voltage and hence, this device is protected**.**

OR

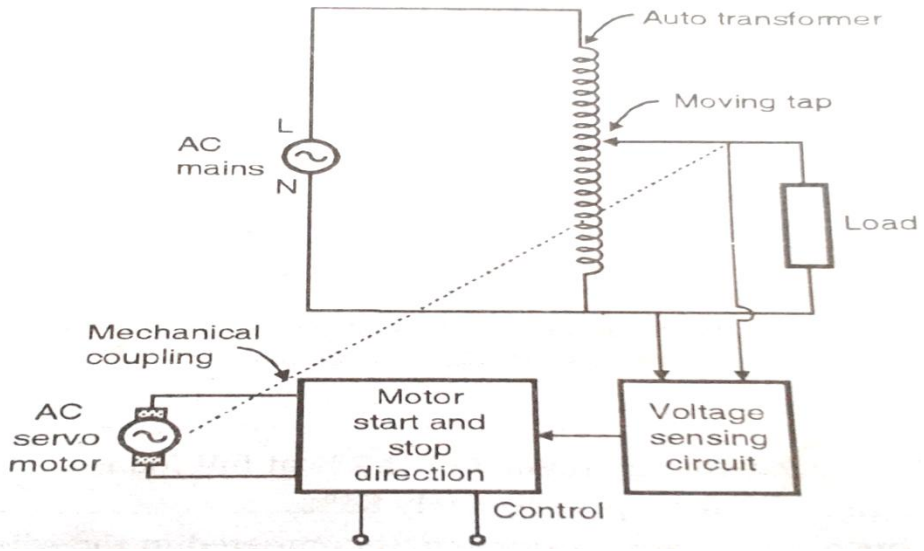
Using MOV:



MOV are voltage dependent resistors. In case of an over-voltage the resistance of MOV reduces and hence it starts conducting and creates a short circuit.

b) Draw the circuit of servo type AC voltage stabilizer and describe its operation.

Ans: Circuit Diagram: 2 marks

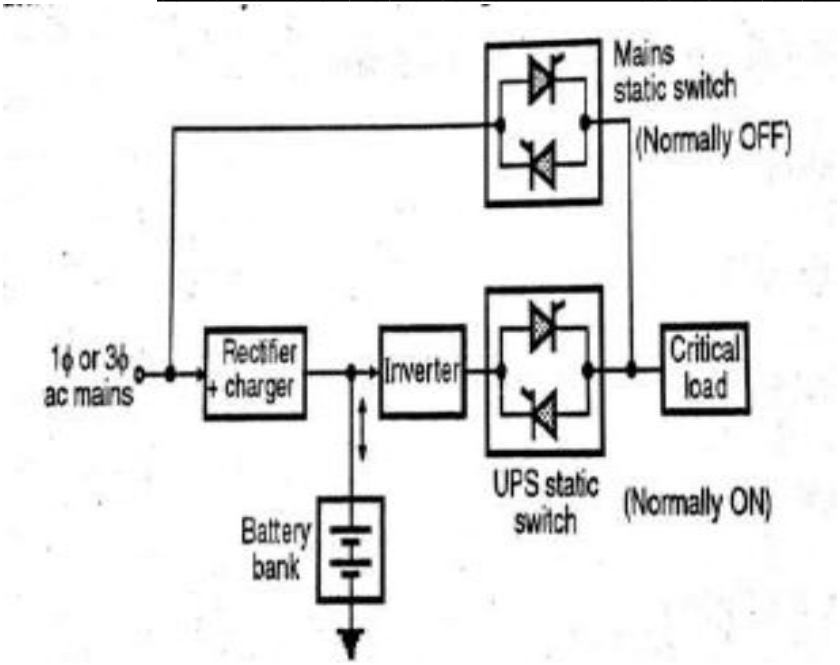


Explanation: 2 Marks

The block diagram of servo type voltage regulator as shown, It uses an ac servo motor which is mechanically coupled to the moving tap of an auto- transformer. The voltage sensing circuit will sense the load voltage and if it is found to be less than or greater than the normal voltage i.e. 230V, the AC servo motor will rotate either in the clockwise or in the anticlockwise direction. Therefore the moving tap of the auto-transformer will also change its position and the necessary corrective action is taken.

c) With the help of suitable diagram, explain the working of ON-LINE UPS.

Ans: Diagram: 2 Marks

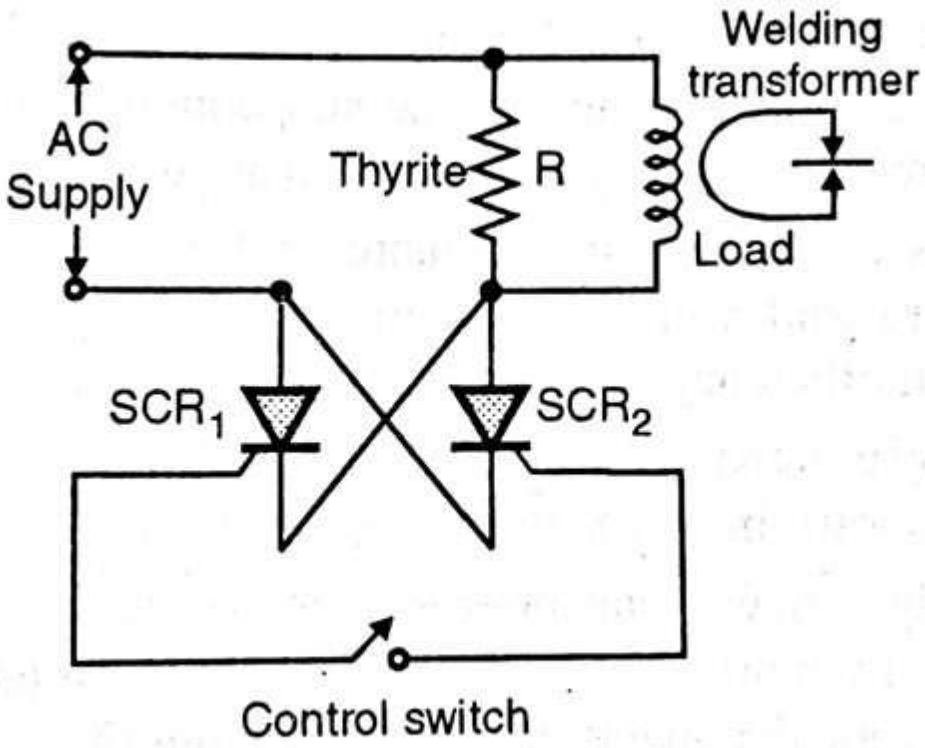


Explanation: **2 marks**

- In ON line UPS the rectifier is used to convert a.c.supply to DC supply which supplies power to the inverter as well as the battery bank to keep it charged.
- Inverter is used to convert DC to AC supply.
- In this, UPS Static Switch is normally ON.
- Mains static switch is Normally OFF and used only when UPS is to be bypassed.
- When UPS fails the UPS Static switch which is normally ON is made OFF and Mains static switch is made ON to connect AC supply directly to load.

d) Draw neat diagram of line contactor using SCR and describe its working.

Ans: Diagram: 2 marks

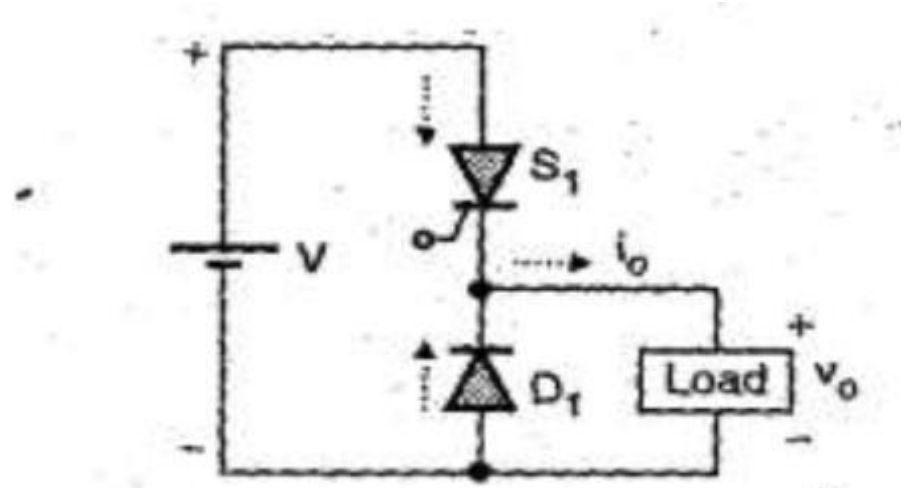


Explanation: 2 Marks

- The circuit consists of two SCR's connected in the inverse parallel or back to back manner.
- It connects or disconnects the primary winding of the welding transformer at the time of welding.
- It is controlled by the control signals from the control circuit.

e) Explain the working of single quadrant class A chopper using SCRs with suitable diagram.

Ans: Diagram: 2 Marks



(a) Type A chopper configuration

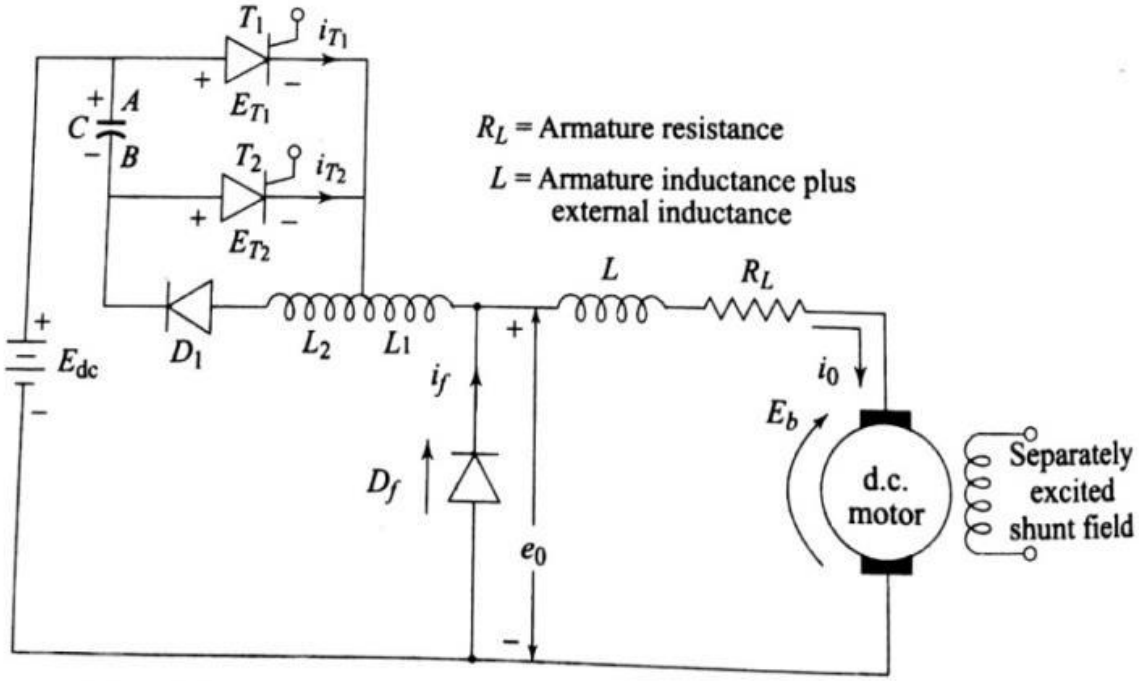
Explanation: 2 Marks

Type A chopper operates with periodic opening and closing of S1.

- S1 and freewheeling diode D1 conduct only in one direction.
- Assume the load is inductive.
- When S1 is closed load voltage is positive, load current is also positive and inductor will store energy.
- When S1 is commutated, there is a change in current.
- Inductor opposes this change and reverses it's polarity.
- This forward biases the diode D1 and freewheeling action takes place.
- Average output voltage and average output current are +ve. Chopper operates in I-quadrant.

Q 4.A) Attempt any three: 12

a) Describe the operation of Jones Chopper with suitable diagram.
Ans: Diagram: 2 Marks



Explanation: 2 Marks

Let us assume, that initially capacitor C is charged to a voltage Edc with the polarity shown in the fig.

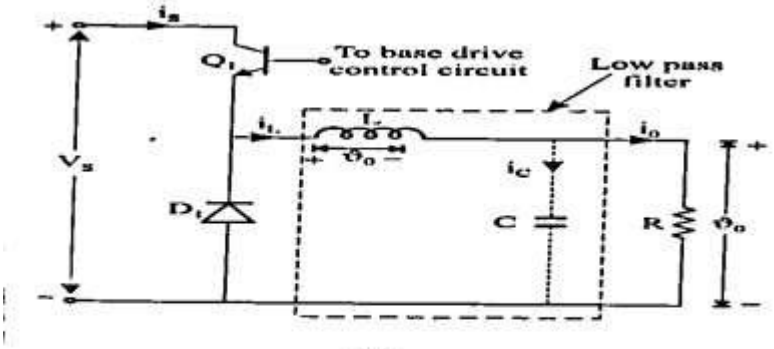
- **SCR T1 is triggered;** a load current flows through T1, L1 and the load.
- Simultaneously current flows through the path C_A-T1 - L2 - D1 - C_B and capacitor C discharges and reverses its polarity i.e. plate B is positive and plate A is negative.
- Diode D1 prevents the reverse discharge.
- Hence, capacitor C holds its charge until SCR T2 is triggered.

- When **SCR T2 is triggered** current flows through the path C_B - T2 - T1 - C_A.
- The capacitor voltage with reverse polarity is applied across the thyristor T1which reverse biases SCR T1 and turns it OFF.
- The capacitor again charges up through supply, C, SCR T2, L1, load with the plate A positive and SCR T2 turns OFF because the current through it falls below the rated holding current value when capacitor C is recharged.
- The load current flows through the freewheeling diode D_f until the thyristor T1 is turned ON again, and thus, the cycle repeats itself.

b) Describe the operation of non-isolated SMPS with diagram.

Note: Any one type can be considered

1. Buck Regulator:
Ans: Diagram: 2 Marks



(a)

Figure Step-down (Buck) regulator:

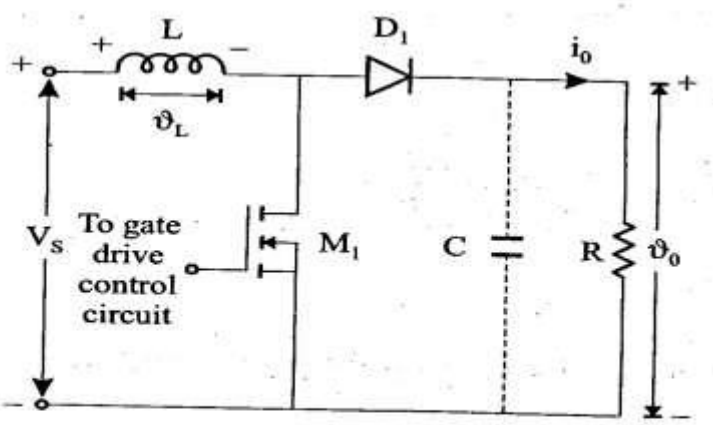
Explanation: 2Marks

The circuit arrangement of such a regulator is shown in figure. Here, switching control is done by a power BJT.

- When the transistor Q1 is switched on, the diode D_1 becomes reverse biased and the input provides energy to the lead as well as to the inductor.
- When the transistor is switched off, an inductor current flows through the flywheel diode D_1, transferring some of its stored energy to the load.
- This inductor current falls until the transistor is switched on again in the next cycle.
- The filter capacitor at the output is assumed to be very large, so that a nearly constant instantaneous output voltage is obtained.

2. Boost Regulator

Diagram: 2 Marks



(a)

Figure Step-up (boost) regulator:

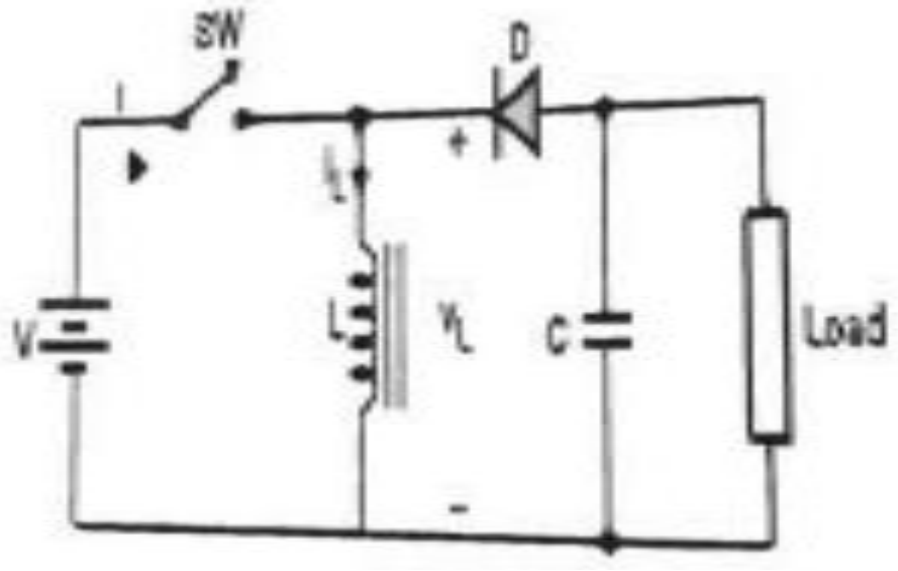
Explanation: 2 Marks

- When the transistor M_1 is switched on, the input current flows through the inductor L and the transistor M_1.
- The flywheel diode D_1 is reverse biased in this case and thus isolates the output stage.

- When the transistor is switched off, the output stage receives a voltage from the inductor along with the supply voltage. This means that the output voltage of the boost regulator is always greater than the input voltage, hence the name boost.

- The voltage at the output can be regulated by adjusting the duty ratio of the circuit.

3. Buck-Boost Regulator
Diagram: 2 Marks



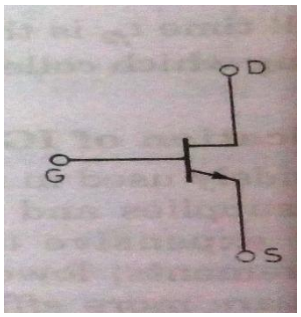
Explanation: 2 marks

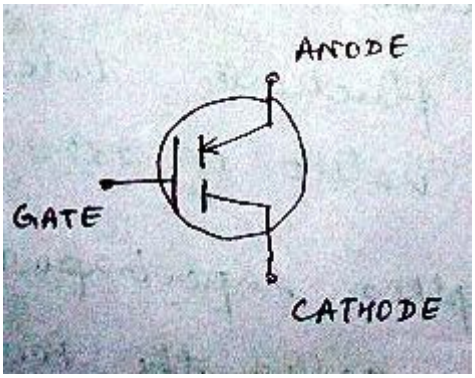
- When Q1 is turned ON the supply voltage V gets connected across the inductance L. The inductance current starts increasing linearly. Diode D1 is reverse biased in this mode. Inductor stores energy.
- Q1 is OFF the current through inductor is interrupted.
- Negative voltage is induced into L which will forward biased D1.
- The load current flows through D1 and L.
- C charges by lower plate positive w.r.t upper plate.
- Mode ends when current through diode reaches zero
- **Mode 3:**
- When all devices are OFF the C will discharge through load due to which output voltage

will be negative.

c) Draw symbol and V-I characteristics of SIT and MCT.
Ans: Symbol-1 Mark, characteristics- 1 Mark

SIT **MCT**





SIT Characteristics **MCT Characteristics**

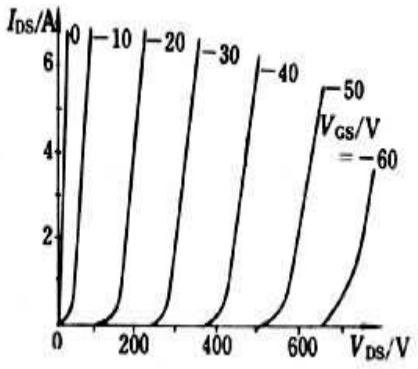
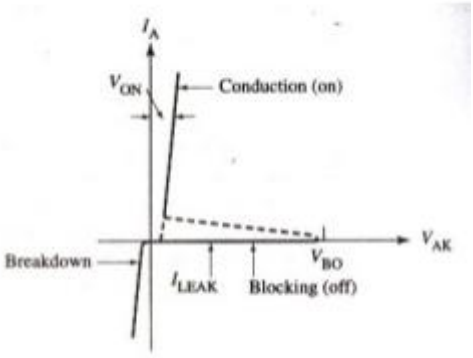


图 3 SIT的输出特性



d) Compare series inverter and parallel inverter on the basis of any four points.
Ans: four points- 4 marks

Note: any other point can also be considered

Parameter	Series Inverter	Parallel Inverter
Commutating Components	In series with load	In parallel with load
Output Waveform	Quasi-sine wave	Approximately square wave
Condition	$R^2<4L/C$	No such condition

Circuit	Less complex	More complex
commutation	Class A	Class C

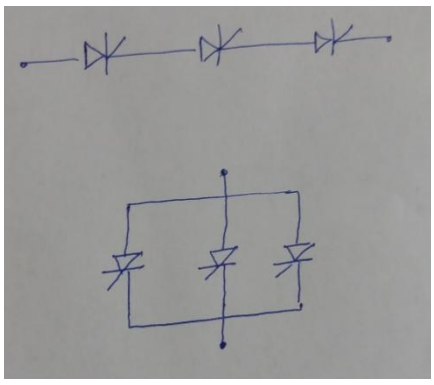
B) Attempt any one: **6**

a) **State the need of series and parallel connections of SCR. Draw circuit diagram of three SCRs in series and parallel connections.**

Ans: Need of series and parallel connections of SCR:- 04M

- The required voltage and current rating are more than the ratings of the available devices then they are connected in series or parallel.
- High power thyristors are not easily available. Therefore low power devices are connected in series or parallel
- Thyristors with high voltage and current ratings are very costly. Therefore instead of using a single high power device it is economical to use low power devices in series or parallel.
- These lower rated SCRs have to be connected in series and parallel combinations to suit the voltage and current requirements.
- Series is used for high voltage low current and parallel is used for low voltage and high current applications

Diagram: Series and Parallel connections of three SCRs—02M (give marks for series & parallel connected SCRs with compensation circuits also)



b) Describe how O/P Voltage of inverter can be controlled using PWM techniques.

NOTE: - Any one method can be considered with diagram 3 marks, explanation 3 marks

The most efficient of controlling the gain and output voltage is to incorporate pulse width modulation control within the inverter. The commonly used PWM techniques are as follows

1) Sinusoidal pulse width modulation

2) Single pulse width modulation

3) Multiple pulse width modulation

Sinusoidal pulse width modulation:

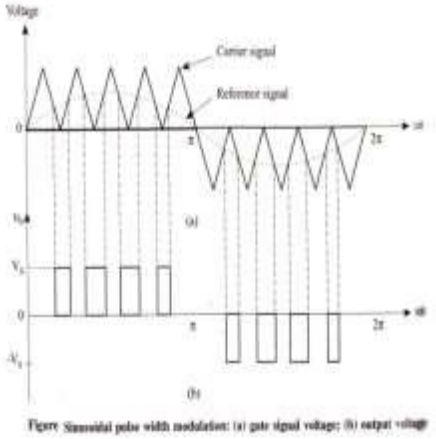


Figure Sinusoidal pulse width modulation: (a) gate signal voltage; (b) output voltage

The PWM waveform generated at the output of the controlled circuit is used to drive transistors or other semiconductor devices connected in the inverter circuit.

- This type of modulation is realized by comparing a control signal consisting of rectified sinusoidal wave of variable magnitude Am and frequency fm= 1/T equal to frequency of inverter & a triangular wave of fixed amplitude and frequency.

- The comparator output is high when the magnitude of sine wave is greater than that of triangular wave. The modulation index of PWM signal is defined as the ratio of: Am/ Ac.The carrier frequency ratio is defined as the ratio of fc to fm.

- This method reduces the harmonics present in the output waveform. A pure quasi square wave is obtained.

- For further reduction in harmonics filter can be used.

Single Pulse-Width Modulation:-

- In single -pulse-width modulation control, there is only one pulse per half-cycle and the width of the pulse is varied to control the inverter output voltage.

- The gating signals are generated by comparing a rectangular reference signal of amplitude Ar with a triangular carrier wave of amplitude Ac.

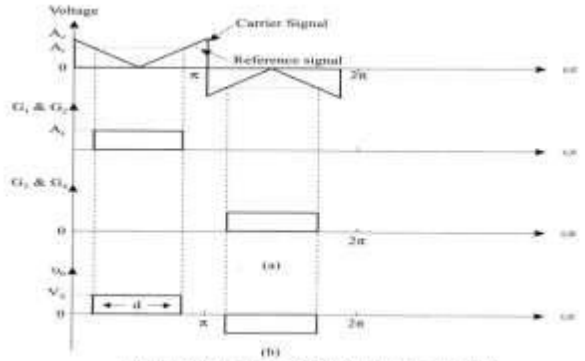


Figure Waveforms of single-pulse width modulation: (a) gate signal generation; (b) output voltage.

Multiple Pulse-Width Modulation:-

- In this method of pulse-width modulation, the harmonic content can be reduced using several pulses in each in each half-cycle of output voltage.

- By comparing a reference signal with a triangular carrier wave, the gating signals are generated for turning-on and turning-off of a thyristor. fc>fm.

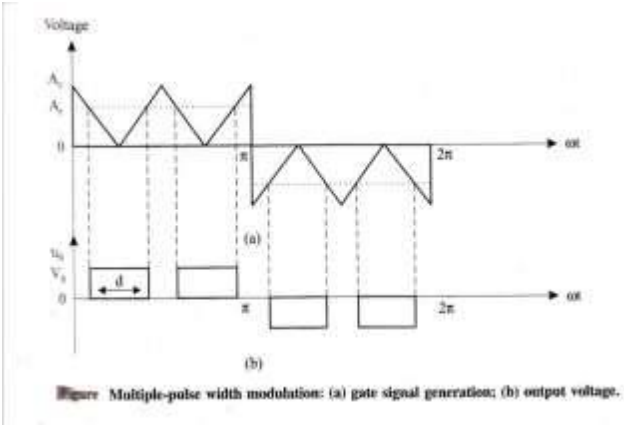


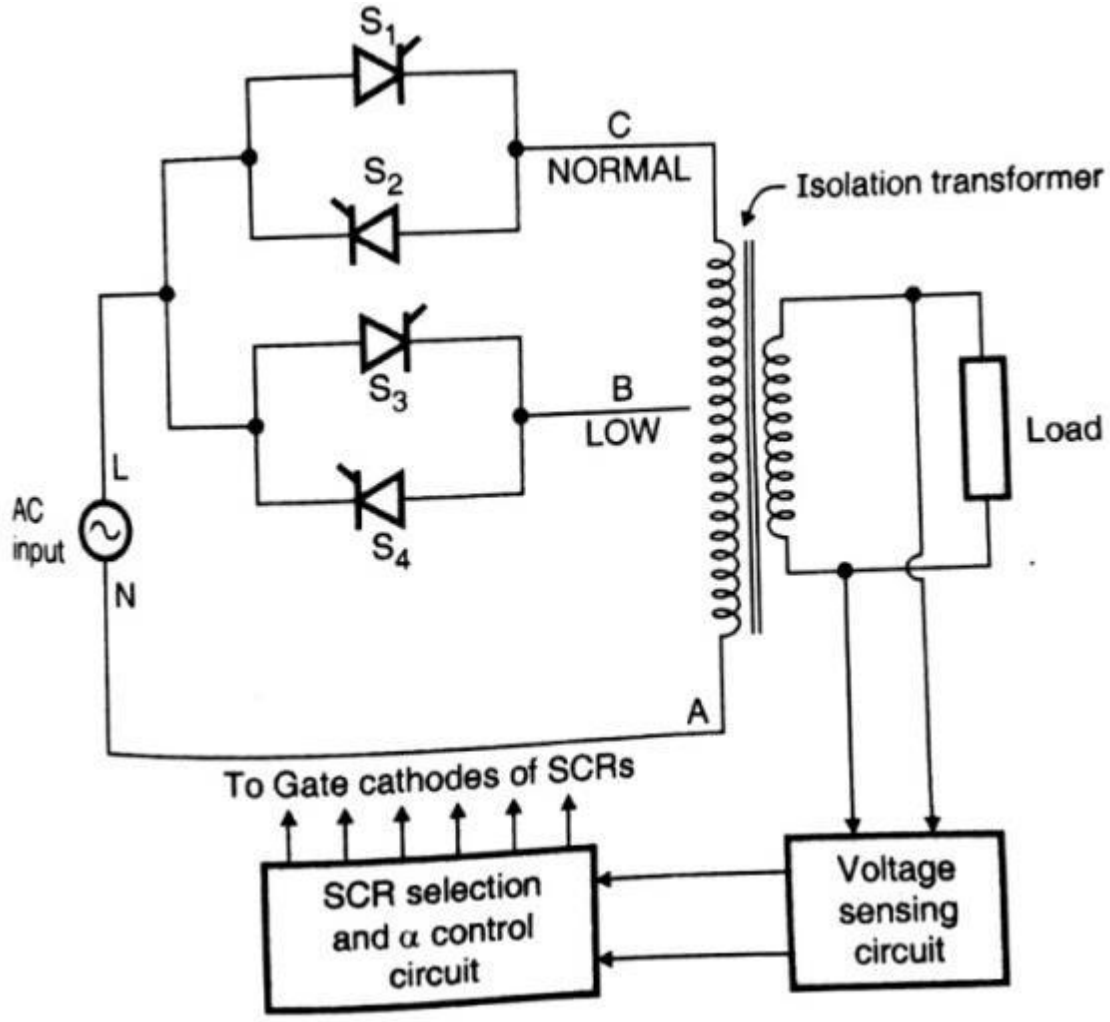
Figure Multiple-pulse width modulation: (a) gate signal generation; (b) output voltage.

Q5. Attempt any two: 16 Marks

a) Describe how voltage is stabilized using phase control method with suitable diagram. List any two advantages of it.

Ans:

a) Diagram: 03M



Explanation: 3M

1. The circuit consists of a tapped transformer along with back to back connected SCRs in pair for each tap.

2. The sensing circuit senses the output voltage and selects a particular tap by triggering the corresponding pair of SCRs. e.g. if the voltage required is 230V then SCR1 and 2 will be triggered.

3. The smooth adjustment in the output voltage is then obtained by automatic adjustment of firing angle of the selected pairs of SCRs.

4 Thus the output voltage can now be adjusted in step less manner.

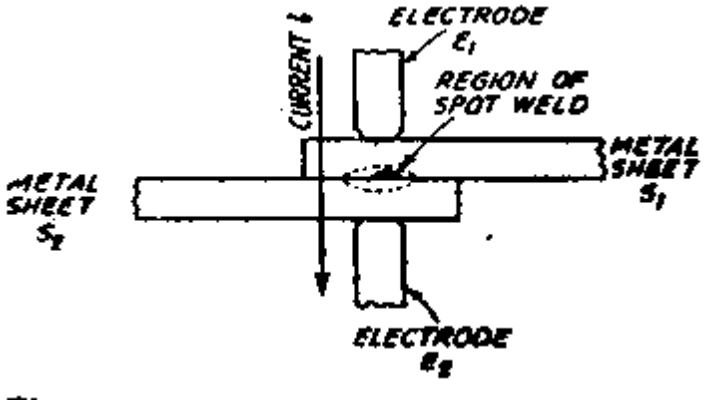
5. If the load voltage required is less, than other pair of SCRs is triggered.

Advantages:2M

1. Simple circuit & Economical
2. Smooth variation of voltage is possible.
3. Better output voltage regulation
4. Good efficiency
5. Fast dynamic response

b) Describe operating principle of resistance welding with neat diagram. Explain types of resistance welding.

Ans: Diagram of resistance welding : 3 marks



Explanation:- **3 marks**

1. The operating principle is based on heating effect of current. Heat is produced due to the resistance offered by the metals sheets to the current passing through them.
2. Heat produced is utilized for welding and Heat = $\int i^2 R\, t$
3. The line contactor is basically a controlled switch which connects the ac mains voltage across the primary winding of the welding transformer.
4. The welding transformer is a step down transformer which supplies a reduced voltage on the secondary side but increases the secondary current which is the welding current.
5. The current is usually in the range of several hundred to several thousands of amperes, depending on the nature of current.

Types of resistance welding: 2 marks

1. Butt welding
2. Spot welding
3. Projection welding
4. Seam welding

c) Describe the operation of isolated SMPS with circuit diagram. List two advantages and disadvantages.

Ans:

Note: Any one type is to be considered

Fly-back converter

Circuit diagram: 2 marks

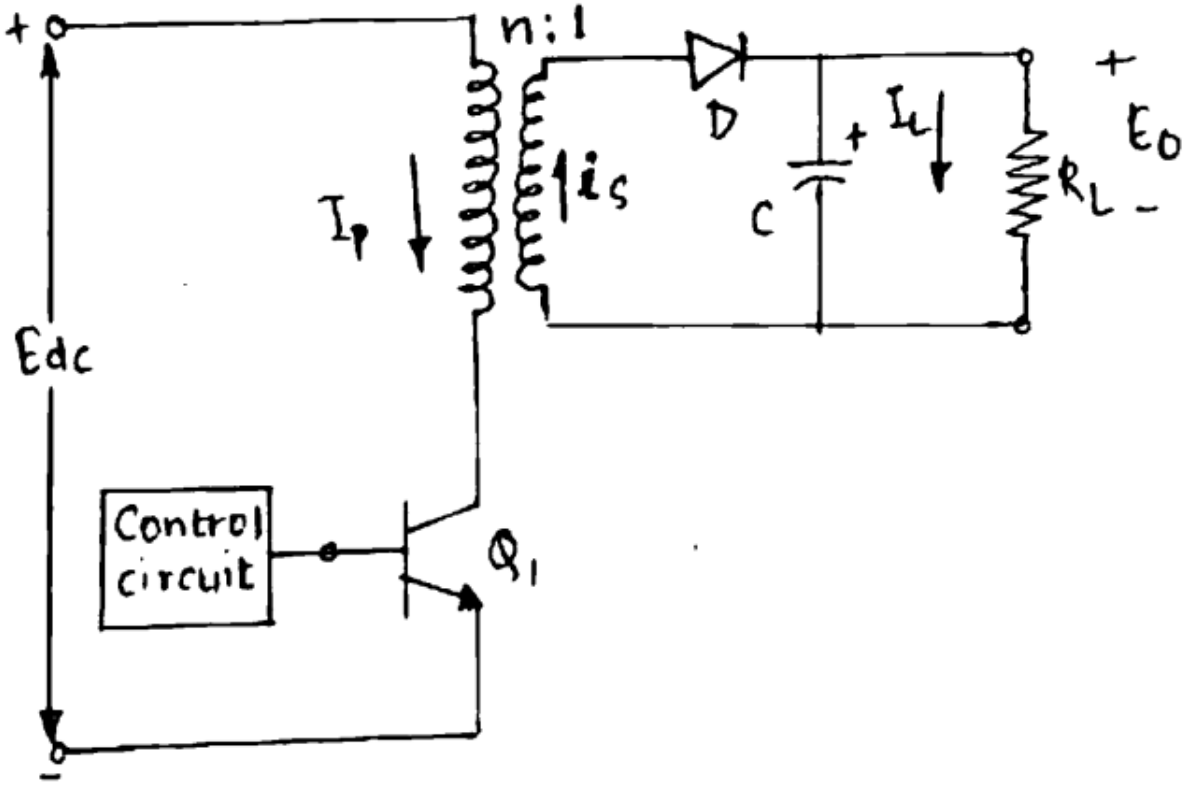


fig: flyback converter

Explanation: 02M

Mode I :

When transistor Q1 is ON at t=0, primary current starts to build up in the primary winding, storing energy. Due to the opposite primary arrangement between the input & output windings of the transformer choke, there is no energy transferred to the load since diode D is reversed biased. Transistor Q1 is turned off abruptly at instant t=t1. The equivalent circuit for this mode is shown in figure

Mode II:

When the transistor is turned off at t=t1, the polarity of the windings reverses due to the collapsing magnetic field. Now, diode D is conducting, charging the output capacitor C and delivering current IL to load .The voltage across Q1 is the sum of input supply voltage (Edc) and the self- induced voltage across the primary winding (Ldi/dt) , therefore it is higher than the supply voltage (Edc).

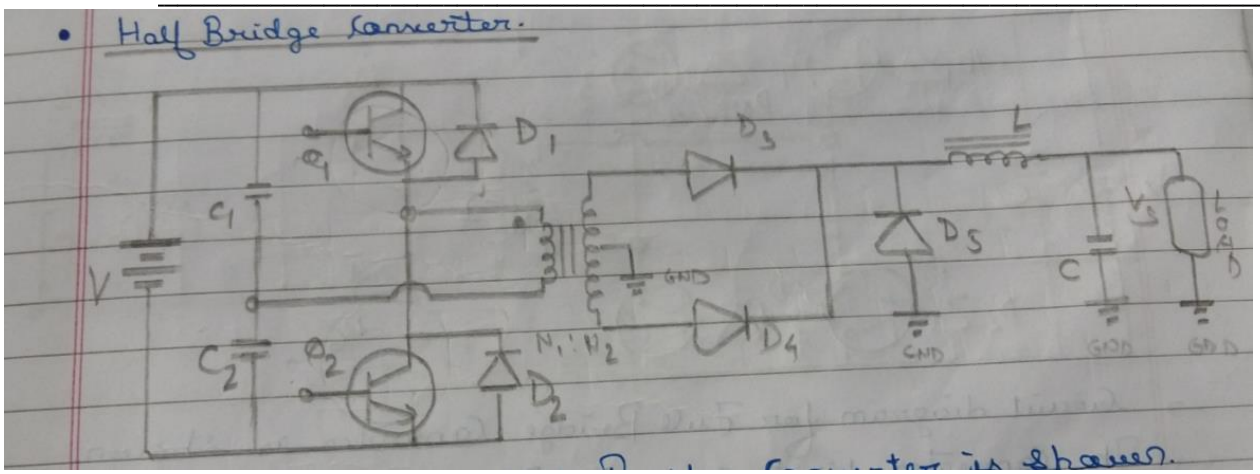
Mode III:

In this mode transistor and diode both are in the off state. Therefore, primary and secondary currents are zero. As there is no voltage drop across primary winding of the transformer, the voltage across the transistor Q1 is equal to the dc supply voltage(Edc). The secondary voltage is zero. The one cycle operation completes in this mode and repeats itself.

OR

Half bridge converter:

Circuit diagram: 02M



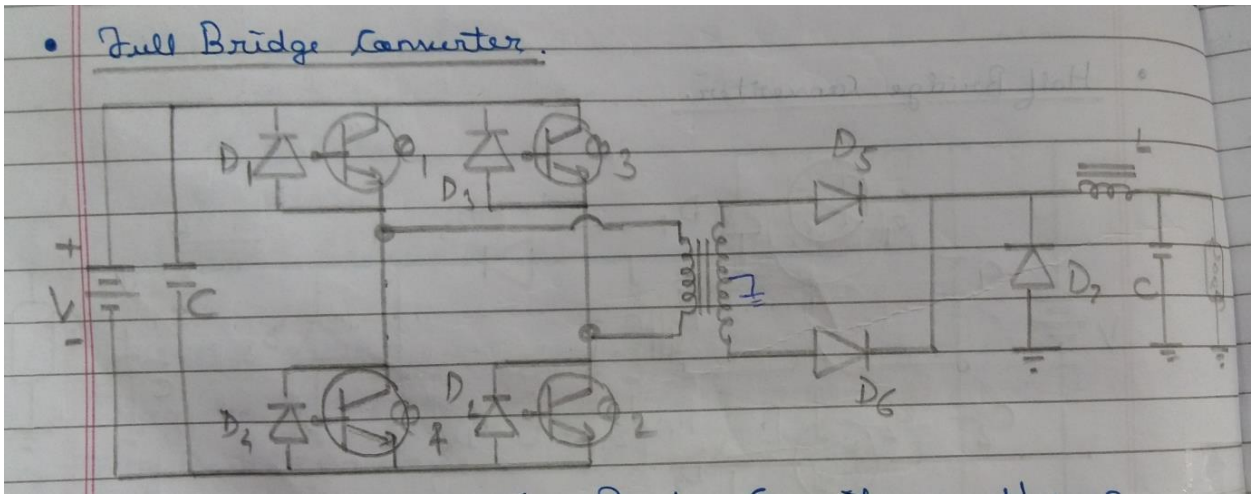
Explanation: 02M

It is a D.C to A.C converter. This output is rectified and filtered by the LC filter. When Q1 is turned ON, voltage across C1 i.e. V/2 appears across the primary of the transformer. D3 is forward biased and D4 is reverse biased. When Q2 is turned ON, voltage across C2 i.e. V/2 appears across the primary of the transformer. D4 is forward biased and D3 is reverse biased.

OR

Full bridge converter:

Circuit Diagram: **02M**

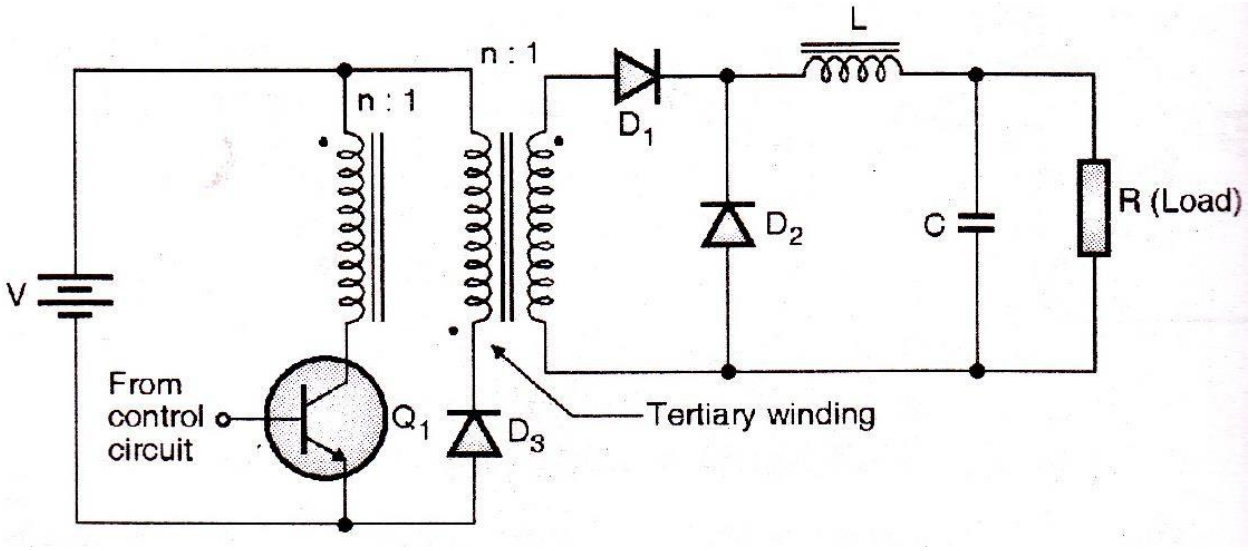


Explanation: 02M

It is a D.C to A.C converter. This output is rectified and filtered by the LC filter. When Q1 and Q2 are turned ON simultaneously, voltage appears across the primary of the transformer. D5 is forward biased and D6 is reverse biased. When Q3 and Q4 are turned ON, voltage appears across the primary of the transformer. D6 is forward biased and D5 is reverse biased.

OR

Forward Converter:- 02M



Operation:- 02M

If you compare the circuit diagram of forward converter with that of a fly-back converter you will find that the configurations are exactly identical to each other except for the winding directions of primary and secondary windings(see the dots on these windings).The operation of the circuit can be explained by dividing it into two modes.

1. Mode I (Q_1 ON) :

1. As soon as Q_1 is turned on, the supply voltage "V" is applied across the primary winding of the transformer.

2. Due to this constant voltage, the primary current increases at a constant rate.

3. Due to the winding polarity as shown in fig., the induced voltage in the secondary winding will forward bias diode D_1 and the secondary current starts flowing.

2. Mode II (Q_1 OFF):

1. When the power switch Q_1 is turned off, the primary voltage will change its polarity as shown in fig.

2. The secondary voltage also will change its polarity.

3. Diode D_1 is reverse biased and D_2 is forward biased due to the induced voltage in the filter inductance and the current flows through the load as shown in fig.

Advantages of isolated SMPS: 2 Marks

1. Electrical isolation is provided between the load and source
2. Good regulation

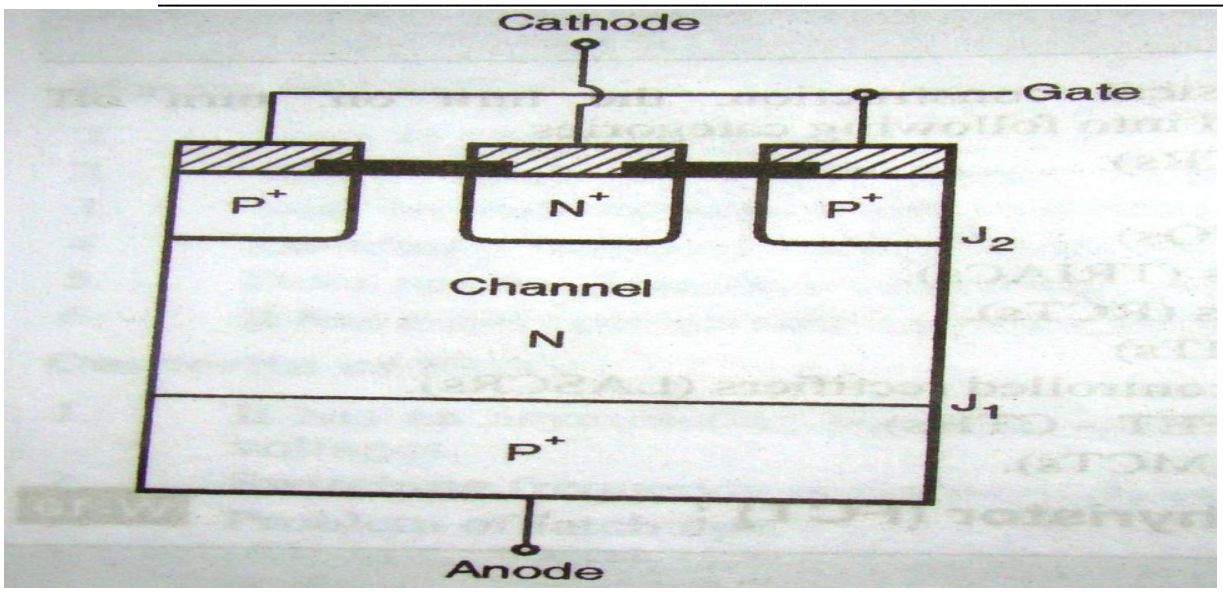
Disadvantages of isolated SMPS: 2 Marks

1. Complicated circuit
2. High cost

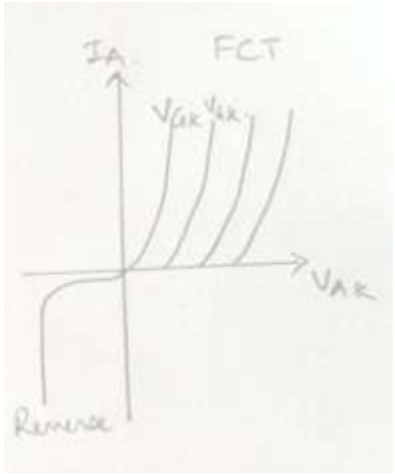
Q6. Attempt any four: 16 marks

a). Draw the constructional diagram of FCT. Draw V-I characteristics of it.

Ans: Constructional diagram: 2 marks



V-I characteristics: 2marks



b) **Distinguish between relay type and servo type AC Voltage stabilizer with reference to operating principle, efficiency, distortion and application.**

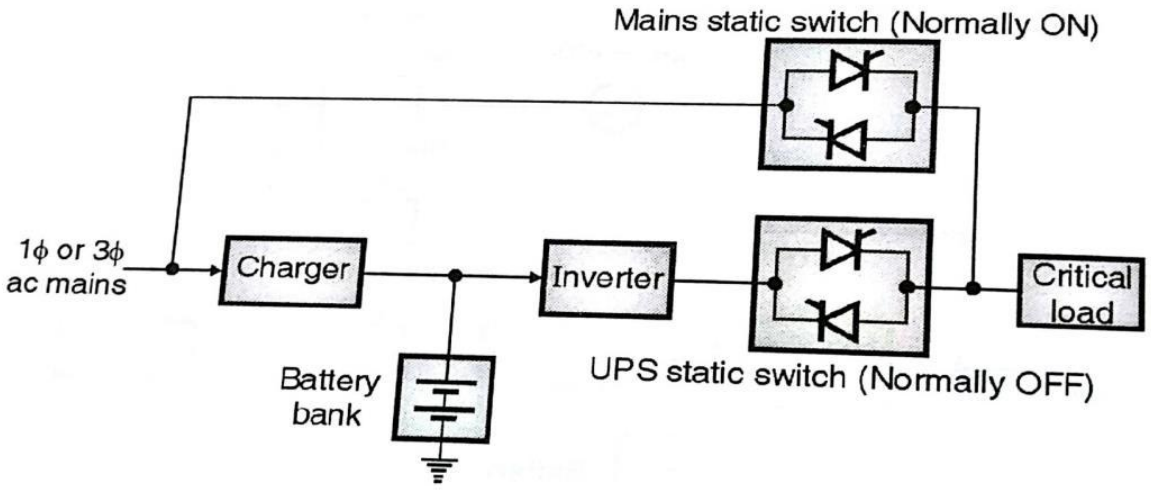
Ans: (Each point 1M)

Sr No	Parameter	Relay type voltage stabilizer	Servo type voltage stabilizer
1	Principle	Relay contacts select tap on transformer	Servomotor rotates the autotransformer

2	Efficiency	70%	>94%
3	Distortion	Less	No distortion
4	Application	TV, refrigerator	computer

c) Draw the block diagram of OFF line UPS and describe its working.

Ans:
Diagram:- 02M



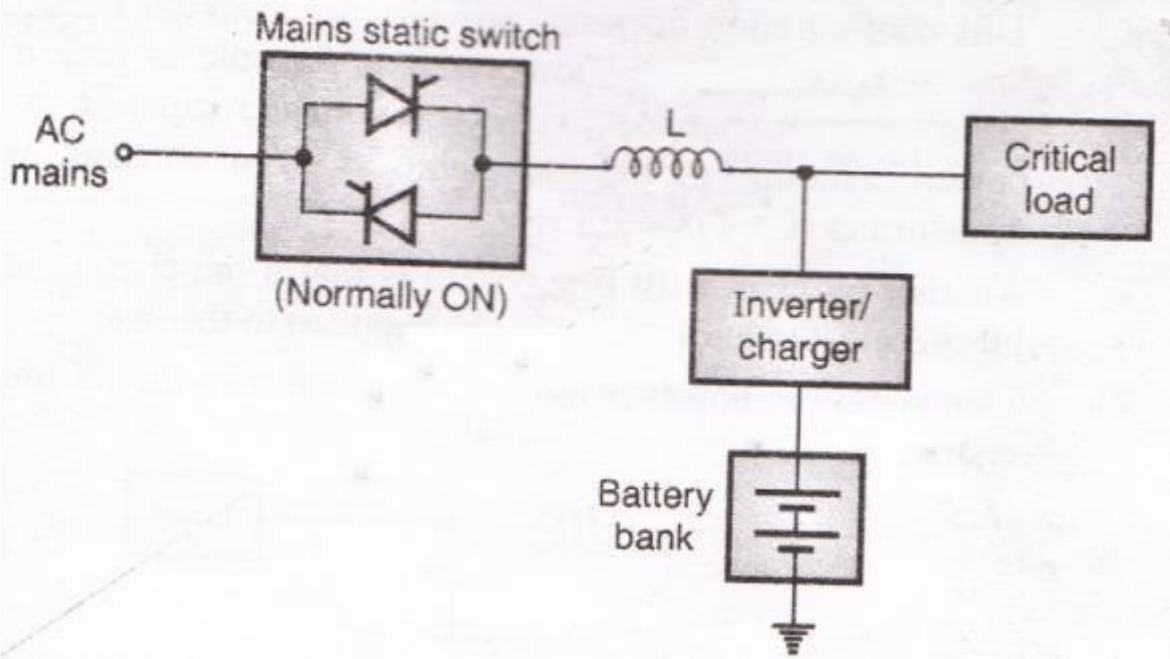
Working: 02M

- A rectifier and charger converts a single phase or three phase a.c voltage into d.c., which supplies power to the inverter as well as the battery bank (to charge it).
- The inverter gets a dc input voltage from the rectifier when the ac mains is ON, and from the battery bank when the ac mains is OFF.
- Inverter converts this dc voltage into ac voltage through a suitable filter and applies it to the load.
- In this, UPS static switch is normally OFF.
- Mains static switch is Normally ON and supplies power to the load.
- When mains fail, the UPS static switch which is normally OFF is made ON and directly connected to the load.
- A static switch will connect or disconnect the battery from the input of the inverter depending on the status of ac mains.

d) **State the need of UPS**. **Draw the diagram of line interactive UPS and describe it's working.**
Ans: Need of UPS—1 Mark

In certain application areas such as personal computers, computer work stations, medical equipment's, ICU need the continuous supply of high quality sinusoidal voltage. For such load the user cannot depend solely on the sinusoidal voltage available at main supply. This is due to frequent outage, poor quality of voltage waveform, fluctuations in mains voltage.

Block diagram of LINE Interactive UPS:- 02M

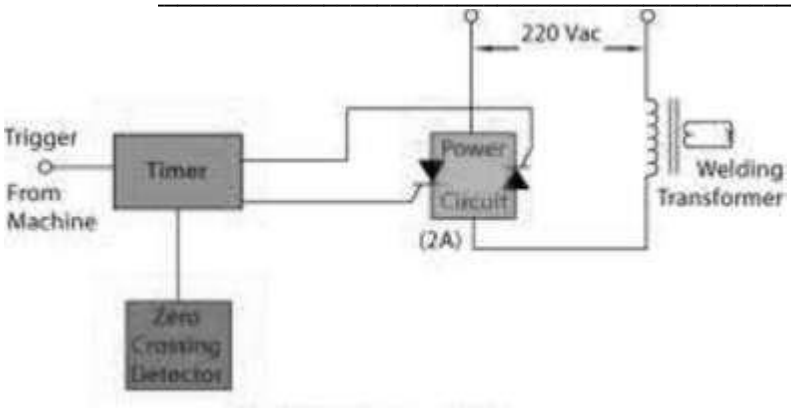


Working: 01M
Mode 1:
The static switch is closed and the load gets connected directly to the ac mains. The inverter /charger block acts as a charger and charges the battery.
Mode 2:
When the mains fail the static switch opens, the inverter /charger block acts as an inverter and the battery supplies power to the load through the inverter**.**

e) **Draw the circuit of synchronous weld control and describe its operation.**

Ans : (Diagram- 2 marks, Explanation- 2marks)

Fig. synchronous weld control (give marks for other relevant ckt diagram also)



Explanation: 2M

- • The welding transformer is considered to be inductive load.
- • It has lagging power factor.
- • Welding current lags voltage by 90 deg for which the system is said to be synchronized.
- • If not, problems occur which causes heating of the transformer.
- Such accurate starting of welding current is called synchronous weld control