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 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: 12M

a) Draw circuit symbol of SIT, FCT and MCT. List any one advantage of each.

Ans: (symbol -1mark each and advantage- 1 mark)

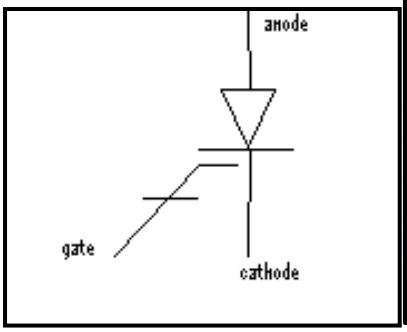


Fig. SIT

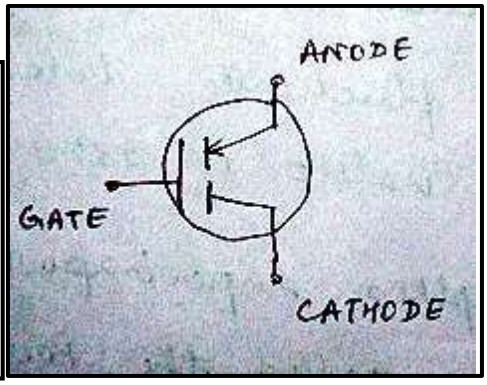


Fig. FCT

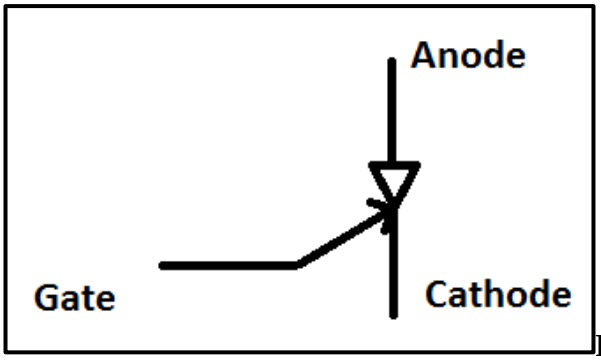


Fig.MCT

Advantages: **[other advantages can be consider]**

SIT – high di/dt and dv/dt ratings, high switching frequency

MCT- low switching losses, fast turn on and turn off time

FCT- fast switching action or turn off time is less

b) Classify choppers on the basis of operation of quadrant. Explain how to obtain variable dc voltage from fixed dc.

Ans: (Classification- 2 marks, working of Chopper -2 marks, circuit diagram optional)

Classification of choppers: **2M**

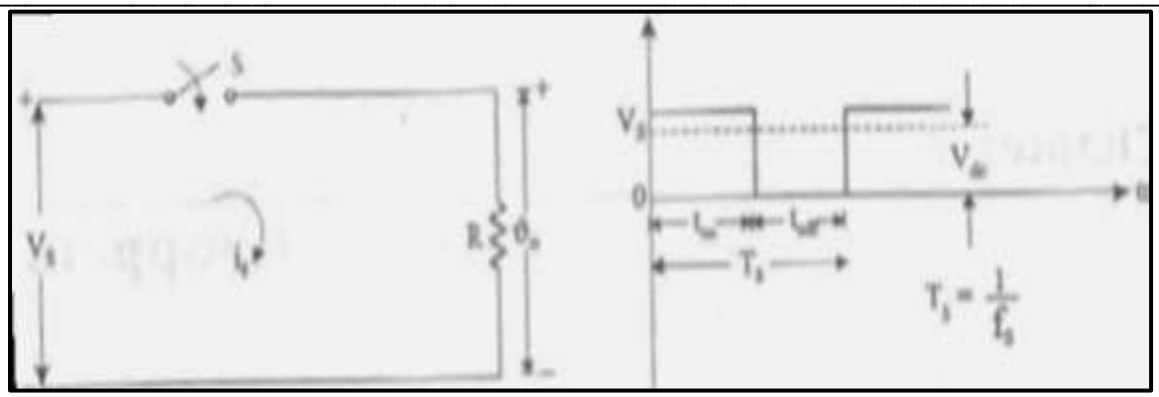
Classification of chopper controlled drives:

1. Depending upon the quadrant of operation:
   - Single quadrant
   - Two quadrant
   - Four quadrant
2. Single quadrant
   - Type A chopper
   - Type B chopper
3. Two quadrant
   - Type C chopper
   - Type D chopper
4. Four quadrant
   - Type E chopper

Chopper: - **2M**

- A chopper is a basically a switch which connects and disconnects the load across the DC input supply.
- The chopper will convert a fixed dc voltage at their input into a variable dc voltage**.**
- Any switching devices like SCR, Power BJT, and Power MOSFET can be used.

Diagram optional:-



Basic dc-dc chopper is shown in figure (a). When the switch S is closed the supply voltage Vs Appears across the load and when it is open, the load is disconnected form the supply. Thus the average dc output voltage is controlled by controlling the switch-On period Ton and the switch-off PeriodT_{off}. Hence the average value, V_{dc} of the output voltage V_o in figure depends on Ton and T_{off}.

i.e. $V_o = [T_{on} / (T_{on} + T_{off})]Vs$

$V_o = D.V_s$

D is called as the duty cycle. As Ton increases, the output voltage Vo increases

c) Draw circuit of parallel inverter using SCR's, with RL load. Draw load current and load voltage waveforms.

Ans: (Diagram 2 Marks, Waveform 2 Marks)

Diagram: **2M**

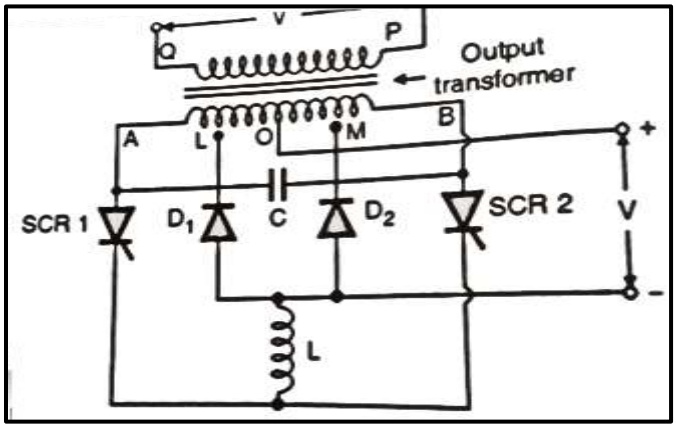
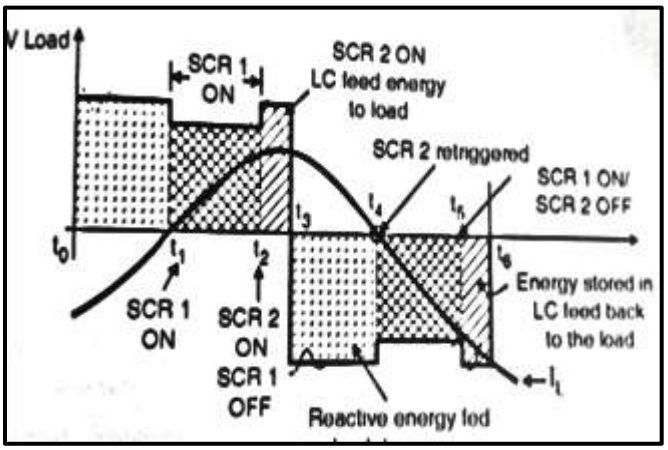


Fig.Parallel inverter

Waveform: **2M**



d) Distinguish between solid state and servo stabilizer with respect to operating principle, efficiency and application.

Ans:

Parameter	**Solid state voltage Stabilizer**	**Servo type voltage stabilizer**
Operating principle-**2M**	Phase control (SCR static switches select transformer tap)	Servomotor is coupled to the tap of the autotransformer
Efficiency- **1M**	High	less
Application - **1M**	TV ,refrigerator	computers

B) Attempt any ONE: 6M

a) Describe working of four quadrant chopper with circuit diagram. List its applications.

Ans: (diagram 2 marks, explanation 2 marks, applications 2 marks)

Diagram: **2M**

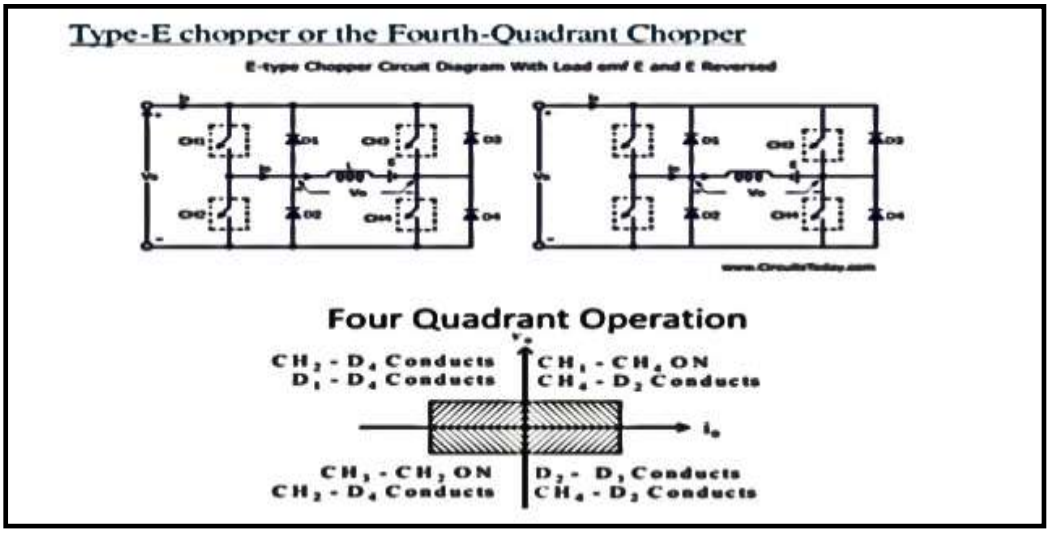


Fig.four quadrant chopper

Explanation:

Type E chopper is a four quadrant chopper.

1. It is a combination of two type D choppers
2. S1S4,D3D2 form one type D chopper which operates in first and fourth quadrant
3. S2S3, D1D4 form the second type D chopper which operates in second and third quadrant.
4. First quadrant operation-Forward motoring:
5. Second quadrant operation-Forward Braking/Regenerative braking
6. Third quadrant operation-Reverse motoring
7. Fourth quadrant operation- Reverse braking/ Regenerative braking

Applications: **2M**

Used in reversible motor drives & speed control of motors

b) Draw series inverter circuit using SCRs. What are its disadvantages? Draw modified series inverter and explain its working.

Ans:

Diagram: **2M**

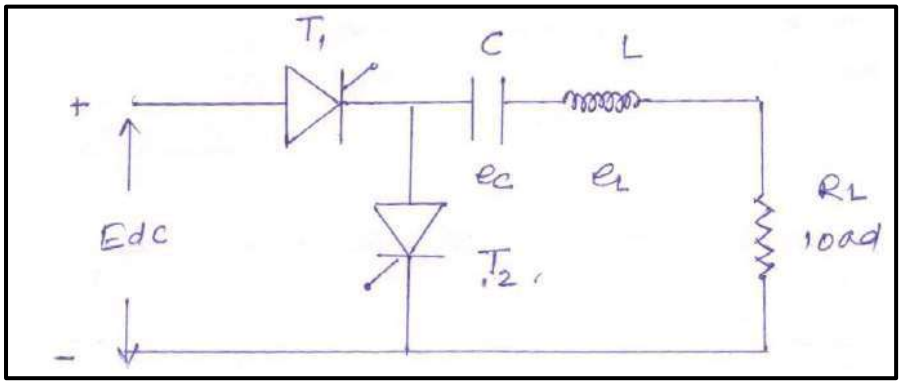
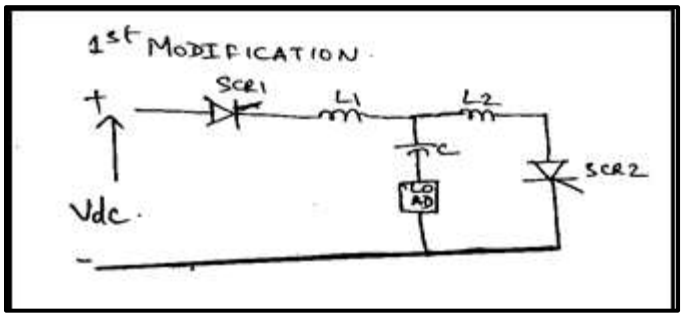


Fig.Series inverter

Drawbacks of series inverter:- **2M**

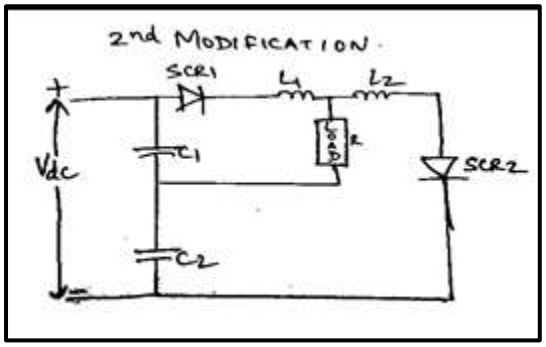
1. The frequency is limited to f= $1/2\pi\sqrt{LC}$
2. SCR 2 should not be turned on when SCR 1 is conducting. This will cause short circuit of the dc source.
3. Power flow from the source is not continuous

Modified series inverter 1/2 mark explanation, 1.5 mark for diagram



It overcomes the drawback of basic series inverter. SCr2 can be turned on even when scr1 is conducting.

OR



50% of the current comes from source and 50% from the capacitor.

Q.2 Attempt any TWO: 16M

a) State the need of series and parallel connections of SCR. Draw neat labeled circuit diagram of three SCRs connected in series combination. Describe the role of static and dynamic equalizing circuit.

Ans: Need for series and parallel connections of SCR :(any two points-2 marks)

Need of series and parallel connections of SCR:- **2M**

- The required voltage and current rating are lower than the maximum limits.
- The designer is forced to use lower rated SCRs for economy and reliability.
- 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 currentapplications.

Diagram:- **2M**

[Note simple series connection of SCR ie without equalizing circuit can be considered]

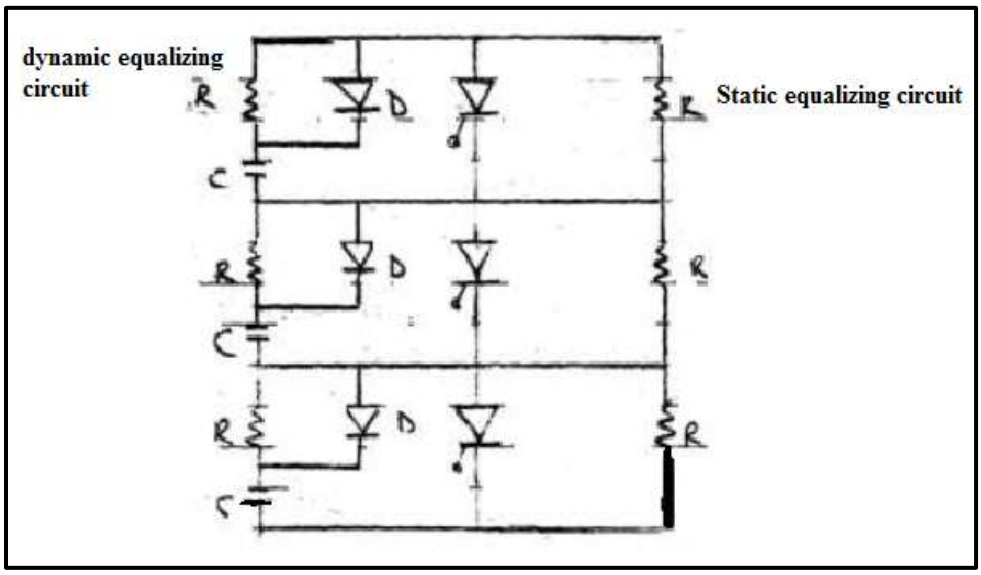


Fig. Static and Dynamic Equalizing Circuit

Role of static and dynamic equalizing circuit:- **4M**

Consider the case of three SCRs connected in series which have different characteristics.

- When voltage is applied across such a combination, then the SCR with the highest turn-on time will share the maximum blocking voltage because the other two SCRs must have already turned on.
- Similarly when reverse voltage is applied across this string SCR with the least recovery time will go to the blocking state first and the other two SCRs will still be conducting.
- These two conditions are unfavorable. Hence static and dynamic equalizing circuits are used. Static equalizing circuit consists of a shunt resistor across each SCR. This reduces the effect of unequal blocking resistances.
- The dynamic equalizing circuit consists of an R-C snubber circuit and a diode. (It is used to

- control the voltage distribution when the SCRs are in the blocking state.) To equalize voltage during transient state ie during turn on and turn off of SCRs

b) With the help of circuit diagram and waveforms, explain Mc- Murray Bed ford full bridge inverter.

Ans: circuit diagram 4 marks, explanation 2 marks and waveform 2 marks

Circuit diagram: **4M**

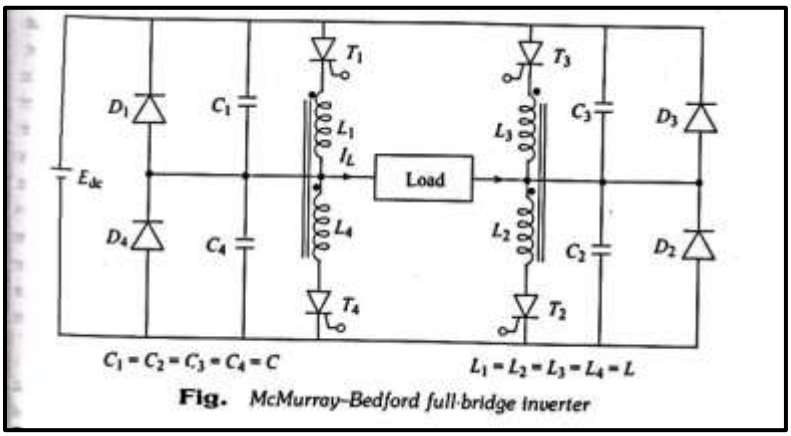


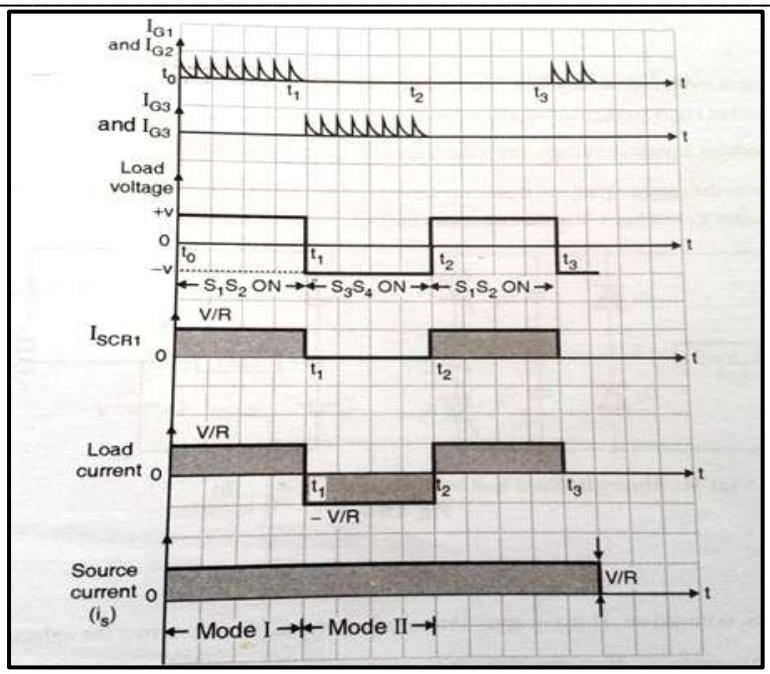
Fig. McMurray–Bedford full-bridge inverter

Fig.Mc- Murray Bed ford full bridge inverter

Working: **2M**

It uses 4 scrs and 4 diodes. When T1 and T2 are turned on, the direction of load current is from A to B and inductor stores energy. When T1 and T2 are turned off, inductor reverses its polarity. D3 and D4 become forward-biased. When T3 and T4 are turned on, the direction of load current is from B to A and inductor stores energy.When T3 and T4 are turned off, inductor reverses its polarity. D1 and D2 become forward-biased.

Waveforms: **2M**



c) Draw block diagram of sequential timer for resistance welding. Describe function of each block. List different signal generated.

Ans: (diagram 4 marks, function 2 marks, different signals 2 marks)

Diagram: **4M**

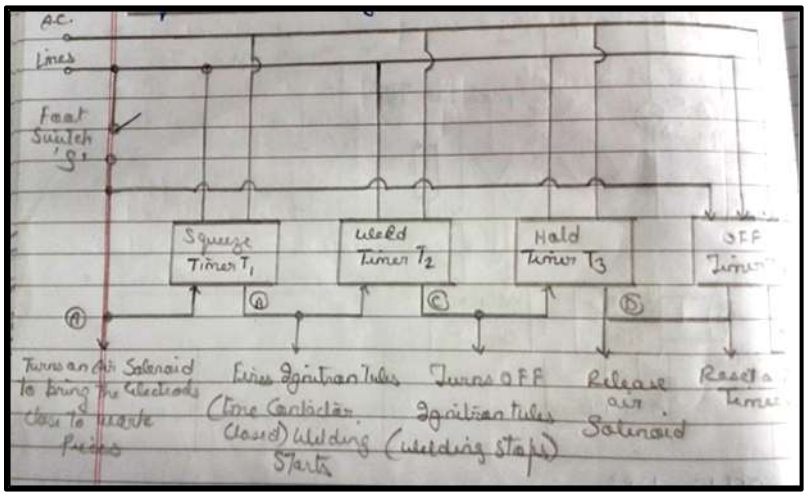


Fig. Block diagram of sequential timer

Functions: **2M**

- Squeeze timer- it turns on the solenoid valve and squeezes the welding electrodes together.
- Weld timer- it operates to initiate the welding current
- Hold timer- it will produce control signals to hold the welding current.

- Off timer- during this time the operator can shift the work-piece to a new spot.

The sequent timer provides the following signals: **2M**

- Signal to squeeze the welding electrodes together.
- Signal to start the flow of welding current
- Signal to stop the flow of welding current
- Signal to separate the electrodes.

Q3 Attempt any FOUR: 16M

a) Describe crowbar protection circuit with neat diagram.

Ans: (Diagram 2 marks)

Diagram: **2M**

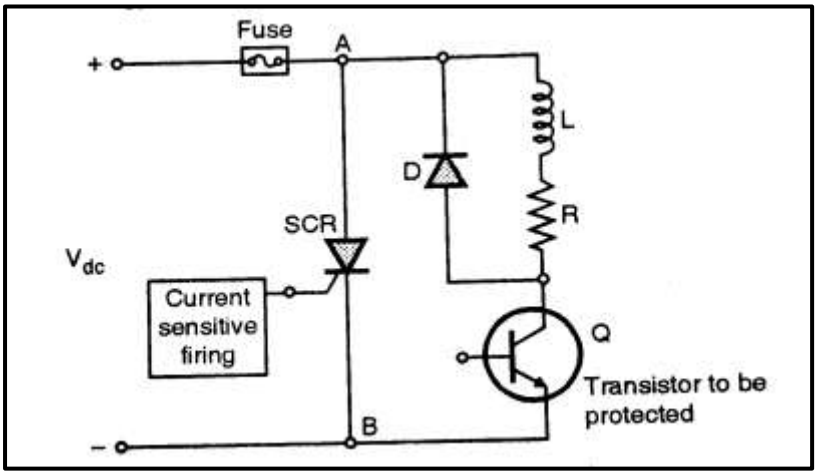


Fig. Crowbar protection

Explanation: **2M**

- It is used to protect device where a large current or power is involved.
- In power converters, fault may take place which result in large fault currents. This fault current must be cleared quickly in order to protect the power devices from getting damaged.
- SCR is used which is normally in off state.
- There is a voltage or current sensitive firing circuit.
- If the current through Q goes above a preset value, then the SCR will be turned ON.
- The SCR will act as a closed switch and will short circuit points A and B.
- So in fault condition, SCR turns ON and will blow the fuse and the transistor Q is protected

b) Draw block diagram of SMPS and explain operation of each block.

Ans:(diagram 2 mark)

Diagram: **2M**

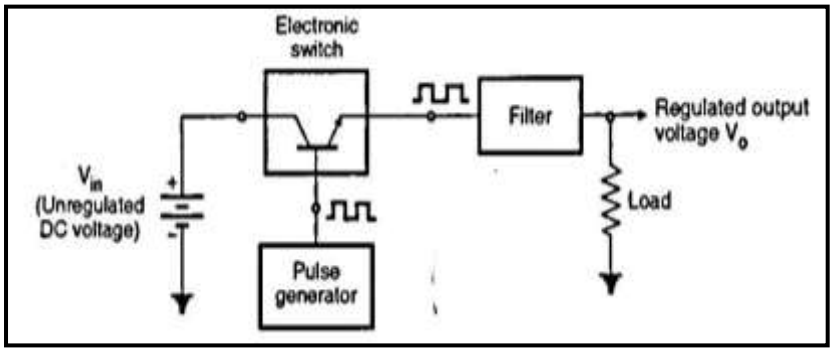
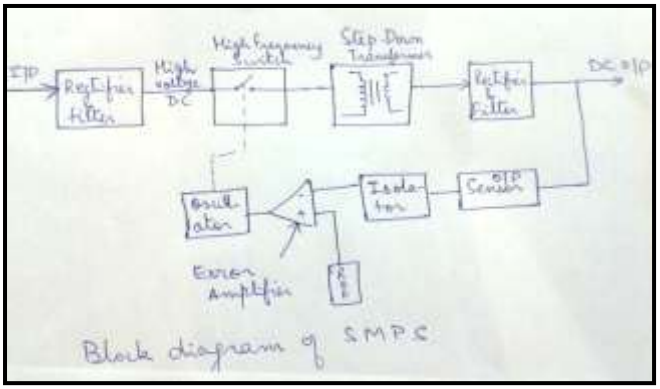


Fig. Block diagram of SMPS

OR



Explanation: **2M**

- The pulse generator generates rectangular pulses which are applied to the control terminal of an electronic switch. This switch is turned on and off with the help of these rectangular pulses. The switch is typically a transistor or MOSFET. It is used in its saturation and cutoff region.
- When the switch is ON, it connects the unregulated dc input V_{in} as it is to the input of the filter and the filter input is disconnected from the dc input voltage Vin when the switch is open circuited.
- Filter input voltage= V_{in}….. When switch is on.
- And filter input voltage= 0….when switch is off.
- The output voltage Vo = D* Vin
- Thus the average output voltage is dependent on the duty cycle D

c) State necessity of UPS. What is meaning of the term Backup time and transfer time.

Ans: (Necessity of UPS- 2 marks)

Necessity of UPS: - **2M**

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.

Back up time:

1M

It is the time period for which the UPS system can supply power to the load, after mains failure has taken place.

Transfer time:

1M

It is the time taken by the UPS system to Switch from mains to battery is known as the transfer time.

d) Draw and explain Morgan's chopper.
Ans: (Diagram of Morgan's chopper- 2 marks, Explanation-2Marks)

Diagram: **2M**

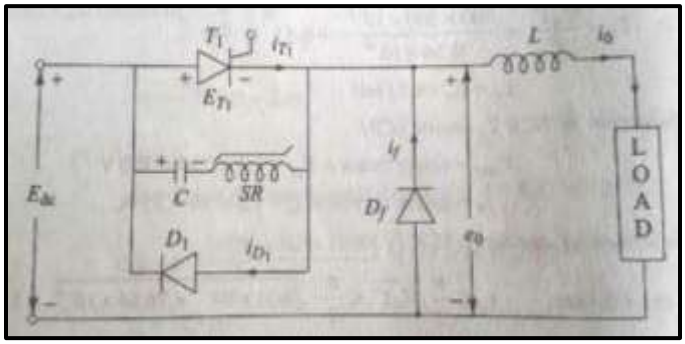


Fig. Morgan's chopper

Explanation: **2M**

- Initially SCR T1 is in the OFF state.
- C1 is charged to the supply voltage Edc and the reactor SR is positive saturated.
- When T1 is triggered, capacitor discharges through T1 and SR.
- After a short period, charge on the capacitor is reversed and the reactor is negatively saturated.
- The impedance of the reactor reduces.
- The reverse voltage of capacitor appears across T1 and turns it off.

e) Draw and describe synchronous weld control.
Ans : (Diagram- 2 marks, Explanation- 2marks)

Diagram: **[waveform is optional]** **2M**

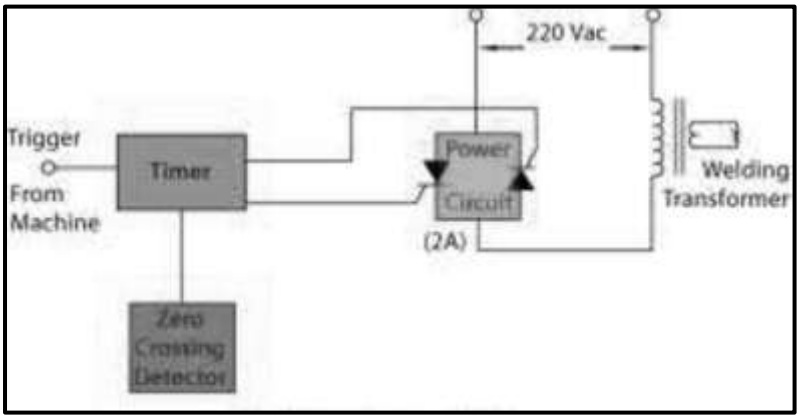
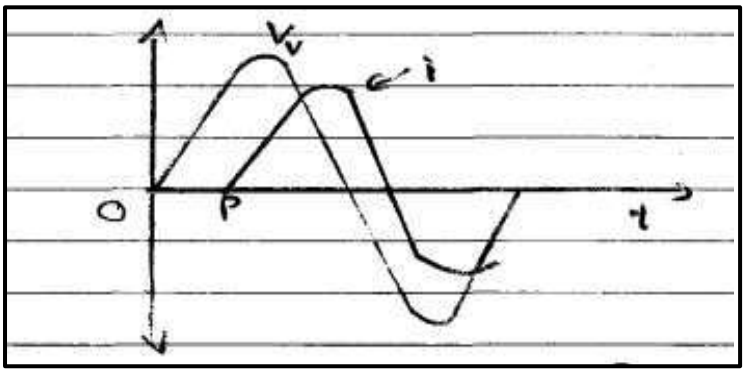


Fig. synchronous weld control



Explanation: **2M**

- The welding transformer is considered to be inductive load.
- It has lagging power factor.
- Welding current lags voltage by 90 deg.
- Supply voltage starts from point O and the welding current starts from point P.
- If the welding machine is switched on now such that the current starts from point P, the system is said to be synchronized.
- If not, problems occur which causes heating of the transformer.
- This is caused due to slow closing of relay contacts.
- Hence, accurate electronic control circuit is required which will cause the relay to close at point P.
- Such accurate starting of welding current is called synchronous weld control.

Q4 A) Attempt any THREE: 12M

a) Draw circuit of Jone's chopper and describe its operation.

Ans: (Diagram 2 marks and explanation 2 marks)

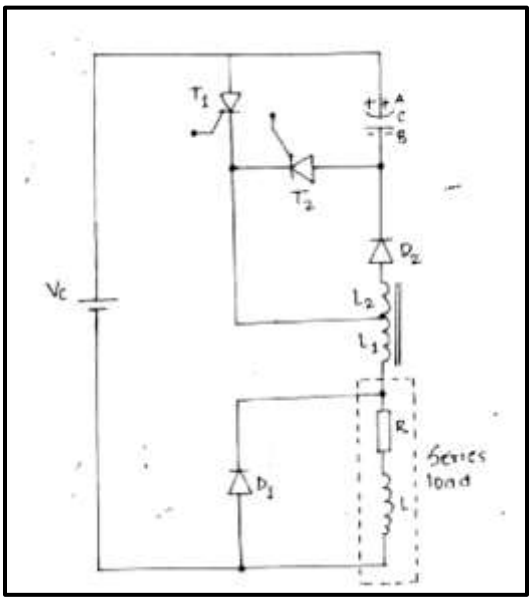


Fig.Jone's chopper

Explanation: **2M**

- Figure shows the circuit diagram of Jone's chopper .In this SCR T1 is main SCR, whereas SCR
- T2, capacitor C, D2 and autotransformer (t) forms the commutating circuit for the main thyristor T1. It is assumed that capacitor C is initially charged to supply voltage V. Class D commutation circuit .Inductors L1 and L2 are closely coupled to form an autotransformer
- If SCR1 is triggered, load gets connected to supply. Vo=Vi Load current flows through T1, L2 and load. Capacitor discharges and recharges in opposite direction through T1, L1 and diode D2 and stores energy to commutate main SCR T1.
- When auxiliary SCR T2 is triggered. The Capacitor C gets effectively connected across T1.
- This reverse biases the SCR T1, and turns it off. Vo=0 The load current is now supplied by V . The Capacitor discharges completely and recharge again to an opposite polarity as the load current continues to flow.
- When the capacitor voltage reaches the supply voltage, the charging current decreases and eventually goes below the holding current for SCR T2. Consequently, SCR T2 turns off.
- When the load current iL=iT2 reaches zero, the induced voltage in the inductance part of the load changes its polarity. Diode D1 is forward biased which allows the energy stored in the inductance of the load is dissipated. All currents increases and the circuit are ready for a gate pulse to arrive at T1 to begin another cycle.
- Because of autotransformer capacitor voltage is maintained equal to supply voltage. Hence provides sure commutation of main SCR.

b) Draw the block diagram of LINE Interactive UPS. Explain its operation, when mains are ON and OFF.

Ans: (block diagram- 2 marks, working-2 marks)

Diagram: **2M**

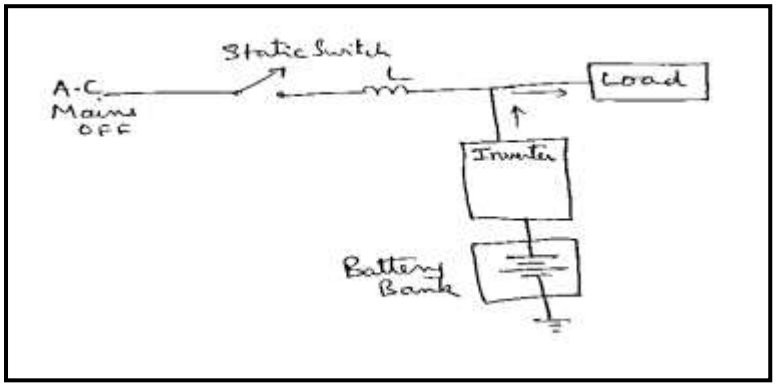


Fig.Block diagram of LINE Interactive UPS

Working: **2M**

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**.**

c) Explain with circuit RC polarized snubber for protection of SCR.

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

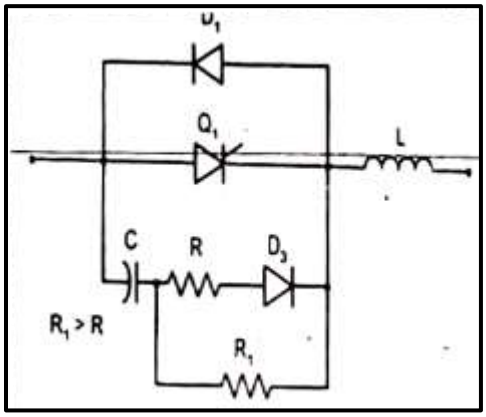


Fig.RC polarized snubber

Explanation: **2M**

- A snubber is a devise used to suppress such as, voltage transients in electrical systems.
- Snubber circuit is required in order to suppress the rate of rise of forward voltage i.e. dv/dtacrossthyristor , limit di/dt and over voltage during turn on and off
- An RCsnubber is normally connected across a semiconductor device to limit the dv/dt within maximum allowable rating**.**

d) Draw and explain circuit of single phase cycloconverter with neat i/p and o/p waveforms.
Ans: Diagram 2 marks (BRIDGE CONFIGURATION)

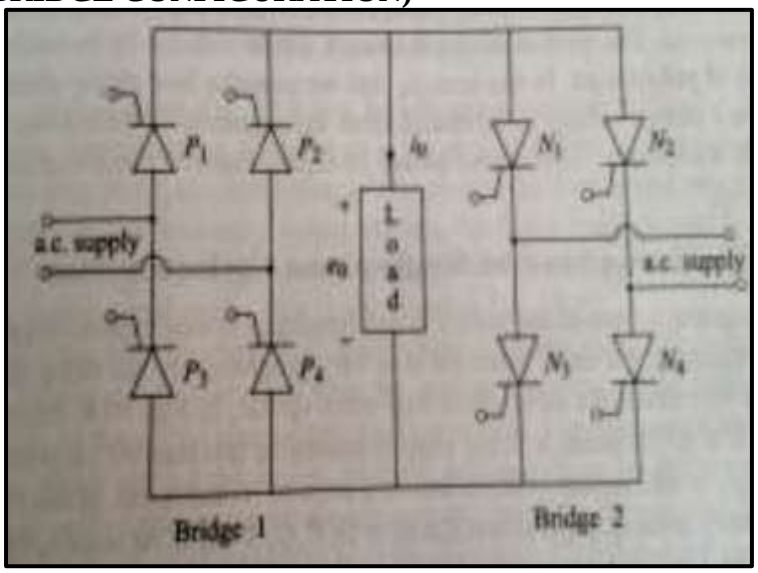


Fig. single phase cycloconverter

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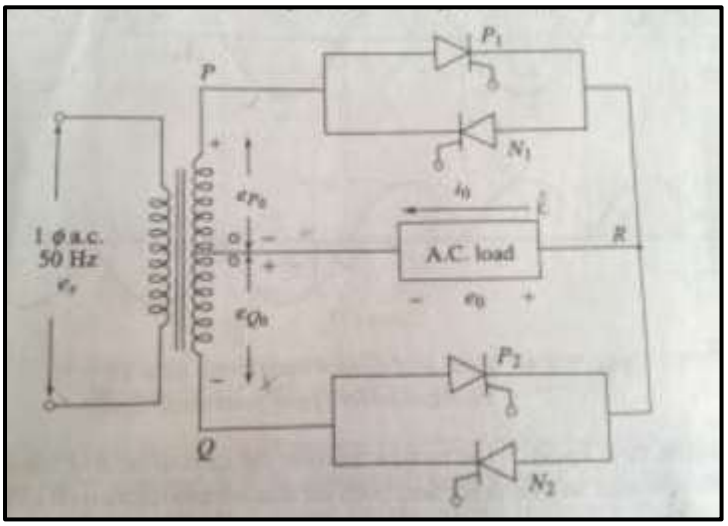
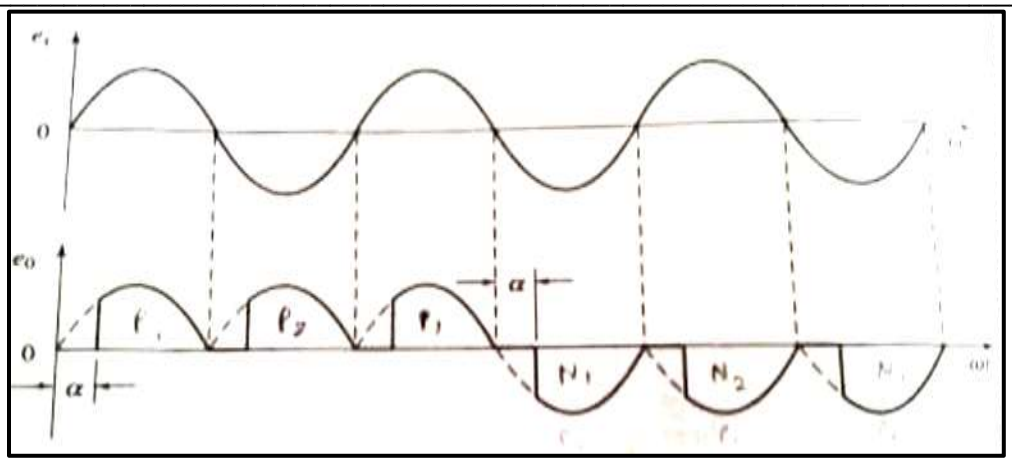


Fig.single phase cycloconverter

Waveform: **1M**



Explanation: **1M**

- 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, and N1.
- The output frequency is reduced to 1/3.

B) Attempt any ONE: 6M

a) How voltage suppression is achieved by selenium diode and MOV, explain with suitable circuit diagram.

Ans: (**explanation 1 mark for each, diagram 2 mark each)**

Selenium diode:

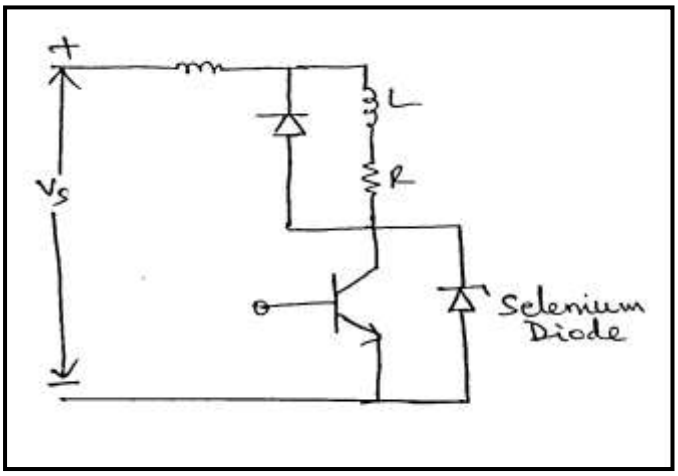


Fig.selenium diode

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**.**

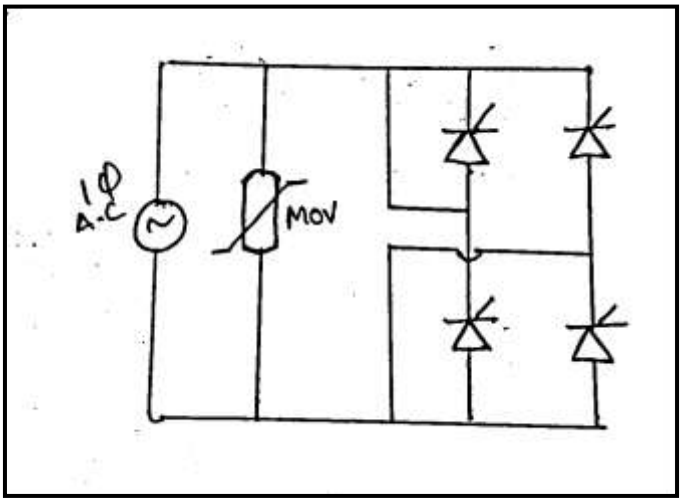


Fig.voltage suppression

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) What are the different types of PWM technique used to control output voltage and harmonics of inverter? Explain it with waveforms.

Ans:-

[NOTE: - List 2 marks; any one method can be considered with diagram 2 mark, explanation 2 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:

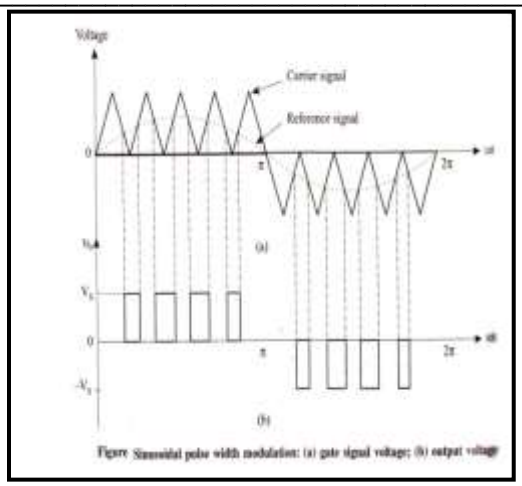


Figure Sinusoidal pulse width modulation: (a) gate signal voltage; (b) output voltage

- 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 Arwith a triangular carrier wave of amplitude Ac.

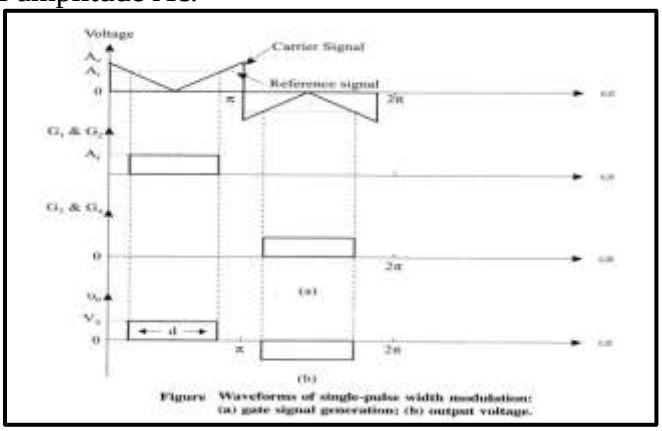


Figure Waveforms of single-pulse width modulation: (a) gate signal generation; (b) output voltage.

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.

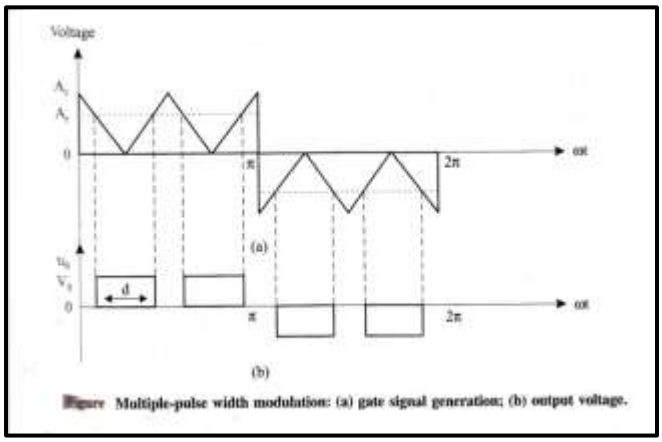


Figure Multiple-pulse width modulation: (a) gate signal generation; (b) output voltage.

Q5. Attempt any Two of following: **16M**

a) Explain need of AC Voltage Stabilizer. Draw the block diagram of tap changing stabilizer. Describe its operation. List its application?

Ans: <u>Need of AC Voltage Stabilizer:</u> **2 marks**

- AC Power line is the 1 phase or 3 phase AC Supply. The requirements of AC Supply are:-
- AC Voltage should be a pure sine wave
- RMS value should be 230 V
- Frequency should be 50 Hz.
- Practically these requirements are not meet easily.
- The power line fluctuates above and below desired value; these are termed as voltage spikes and surges.
- The power line disturbances fluctuates the RMS value. Thus we need to stabilize the fluctuating supply voltage which is done by using AC Voltage Regulator.

Tap Changing AC Voltage Stabilizer: **3 marks**

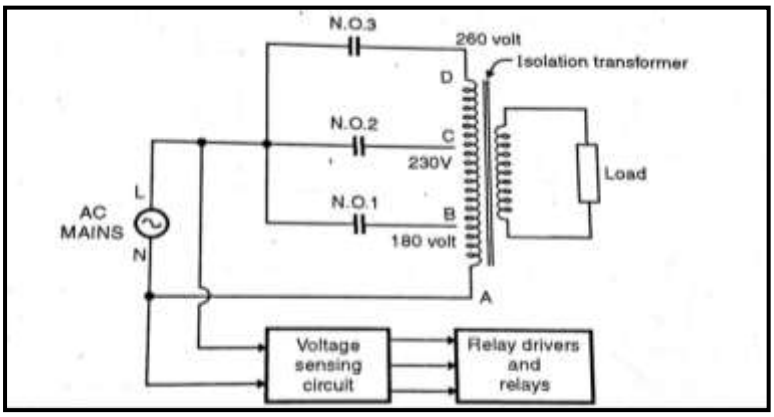


Fig. Tap Changing AC Voltage Stabilizer

Operation: **2 marks**

- The primary winding of transformer is divided into several taps. One end (A) of the transformer is connected to Neutral point of AC Supply and the live terminal is connected to taps through NO of the relay.
- The sensing circuit senses the i/p voltage and selects any one relay out of connected ones.
- If 230 Volts is required then tap 2 is selected by using NO2 contact.
- If no. of taps increased the o/p voltage regulation also will improve.

Applications : **(1 mark)**

- Refrigerators
- TV's

b) State principle of Resistance welding. Explain magnetic energy storage welding with waveforms. State any two advantages and disadvantages?

Ans:

Principle: **2 mark**

Due to the flow of welding current through the electrodes and the metal pieces, the temperature of the common surface of sheets in the region shown by the dotted lines will increase, until the two pieces of metal fuse together under the pressure of the electrodes.The heat is produced due to resistance offered by the metal sheets to the current passing through them.

Note: 1 mark can be given even if circuit diagram is drawn.

Magnetic Energy Storage Welding :(2 marks)

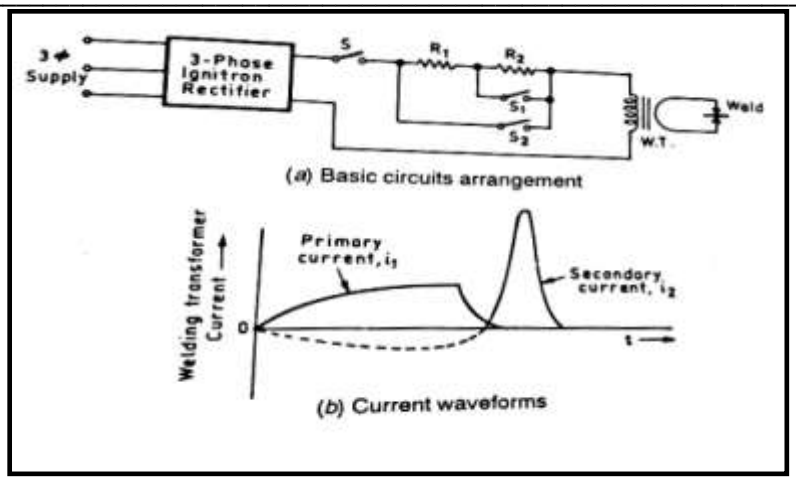


Fig. Magnetic Energy Storage Welding

Operation :(2 marks)

- On closing switches S, S1 and S2 the 3 phase ignitron rectifier supplies a DC current i1 to the primary of the welding transformer
- This current increases exponentially with a large time constant caused by the large inductance of the transformer primary.
- The induced secondary current i2 is small and serves to preheat the weld.
- The energy stored in the core is given by $W=L_i^2/2$
- When primary current i1 reaches a sufficiently large predetermined value representative of the desired stored energy, then the contactors are opened in very rapid sequence S2, S1 and S
- The resulting rapid decay of magnetic flux induces a high secondary current
- The surge of secondary current flowing through the welding electrodes performs the welding operation.

Advantages: - (1 mark)

- Short period of heavy current drainage is avoided
- Voltage fluctuation is eliminated

Disadvantages: - (1 mark)

- This system of welding is suitable for aluminum and other materials having low resistivity and high thermal conductivity
- Highly expensive

c) What are various types of Non Isolated Switching Regulators? Explain any one with circuit and list any two advantages and disadvantages?

Ans: Various types of non-isolated switching regulators: - (2 marks)

- Buck Regulator
- Boost Regulator

- Buck-Boost Regulator

Diagram 2 marks and explanation 2 marks, any one type should be considered.

Buck Regulator:

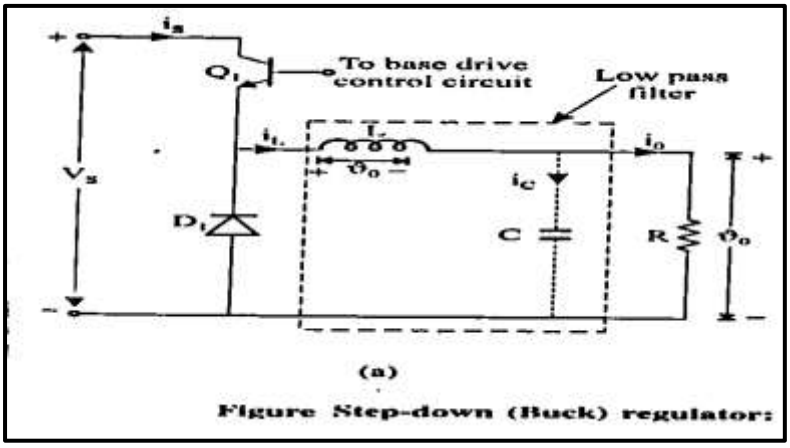


Figure Step-down (Buck) regulator:

- 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.

Boost Regulator:

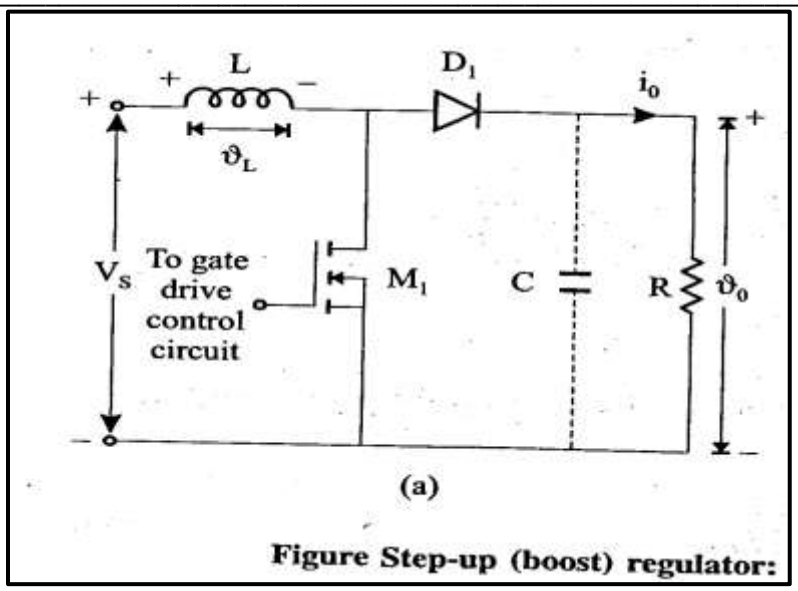
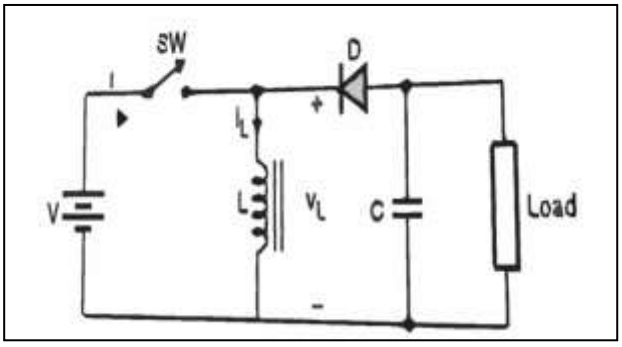


Figure Step-up (boost) regulator:

- 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.

Buck Boost Regulator:



Operation:

- **Mode 1:**

- When Q1 is turned ON the supply voltage V gets connected across the inductance L. The inductance current starts increasing linearly. Diode D1 is reversebiased in this mode. Inductor stores energy.

- **Mode 2:**
  - 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.

Disadvantages: - (1 mark)

- No electrical isolation is provided between the load and source
- Poor regulation

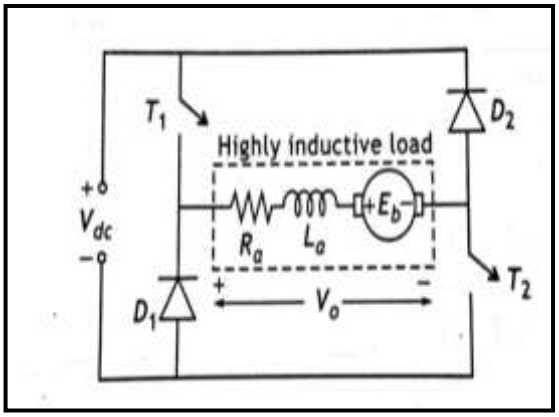
Advantages: - (1 mark)

- Simple circuit
- Low cost

Q6. Attempt any FOUR: 16M

a) Draw and describe working of Class D Chopper?

Ans:(diagram-2 marks, working-2marks)



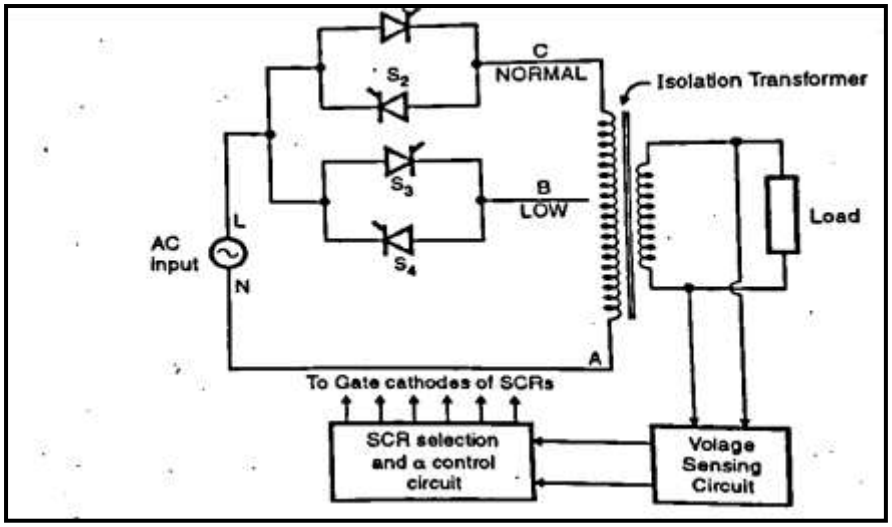
Working:-

- When T1 and T2 are ON. The current flows through $+V_{dc}$->T1->Load->T2->-V_{dc}. During this condition the Voltage and current both are positive.
- Now when T1 & T2 are OFF then diodes D1 & D2 are Forward Biased due to which the voltage reversal occurs. The current direction remains the same.
- Thus for the complete operation the current remains +ve but the voltage reversal takes place. Thus the chopper works in the 1st and 4th Quadrants.

b) Draw and explain block diagram of Phase Control AC Voltage Stabilizer?

Ans: (diagram-2marks, explaination-2marks)

Block diagram of Phase Control AC Voltage Stabilizer:

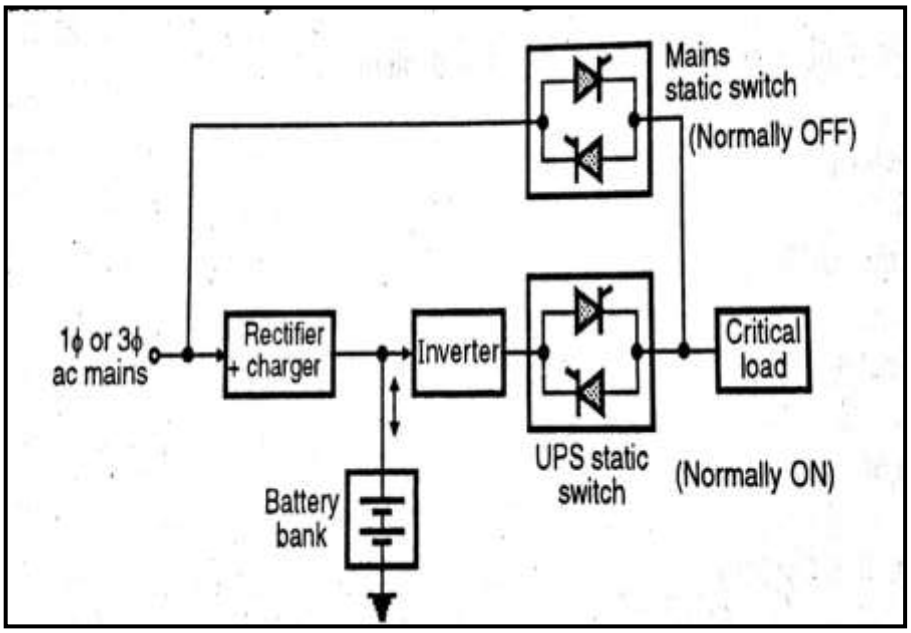


Operation:-

- The circuit consists of a tapped transformer along with back to back connected SCR's in pair for each tap.
- The sensing circuit senses the output voltage and selects a particular tap by triggering the corresponding pair of SCR's. E.g. If the voltage required is 230 Volts then SCR 1 and 2 will be triggered
- The smooth adjustment in the output voltage is then obtained by automatic adjustment of firing angle of the selected pairs of SCR's. Thus the output voltage now can be adjusted in step less manner.
- If the load voltage required is less than other pair of SCR's is triggered.

c) Draw block diagram of ON Line UPS. Explain function of each block?

Ans: (diagram-2marks, explaination-2marks)



Explanation:

- 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 circuit of Line Contractor using SCR and describe its operation.

Ans: (diagram-2marks, explaination-2marks)

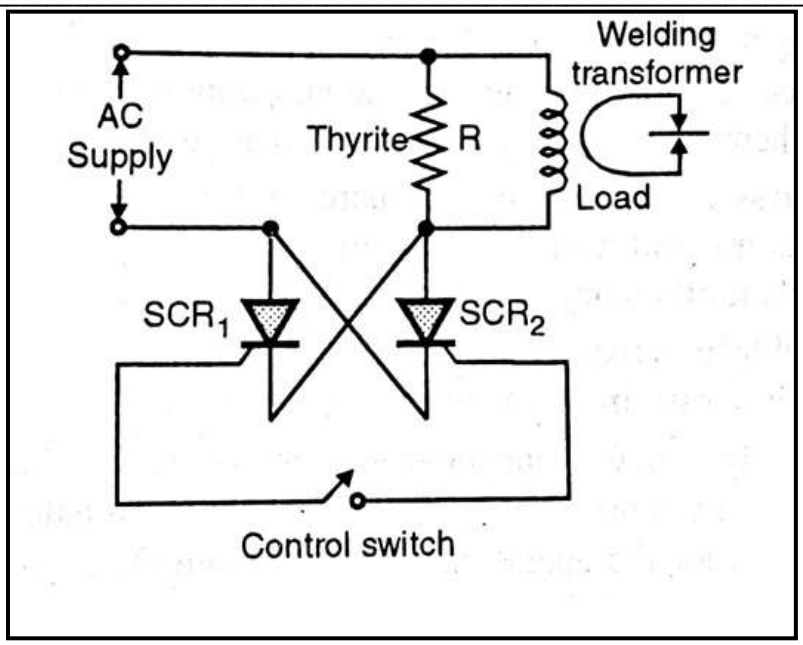


Fig. Line contractor using SCR.

- 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) Difference between ON line and OFF Line UPS.

Ans: (1mark each)

Parameter	ON Line UPS	OFF Line UPS
Power Rating	1kVA, 2kVA, etc.(highest)	5kVA and morelowest
Efficiency	Low	High
Transfer Time	0	<5ms
Applications	Medical Equipment or for critical load	Computer and Electrical Equipment like Lights and fans.Or for general purpose load