

WINTER- 14 EXAMINATION
Model Answer

Subject Code: 17541

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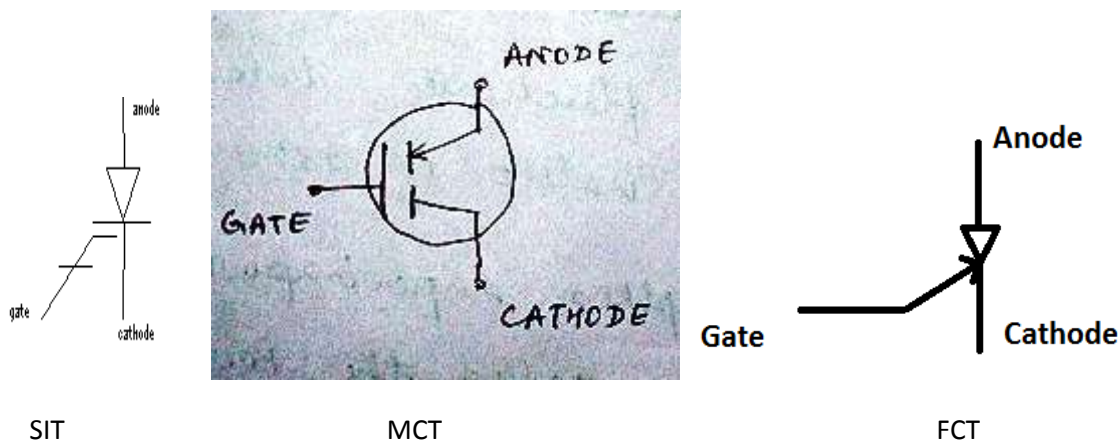
Important Instructions to examiners:

- 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.

Q1. A) Attempt any **THREE** of the following:

(i). Draw symbols of SIT, MCT and FCT. Draw the V-I characteristics of each.

Ans: Symbol- 2 marks each and V-I characteristics: 2 marks each

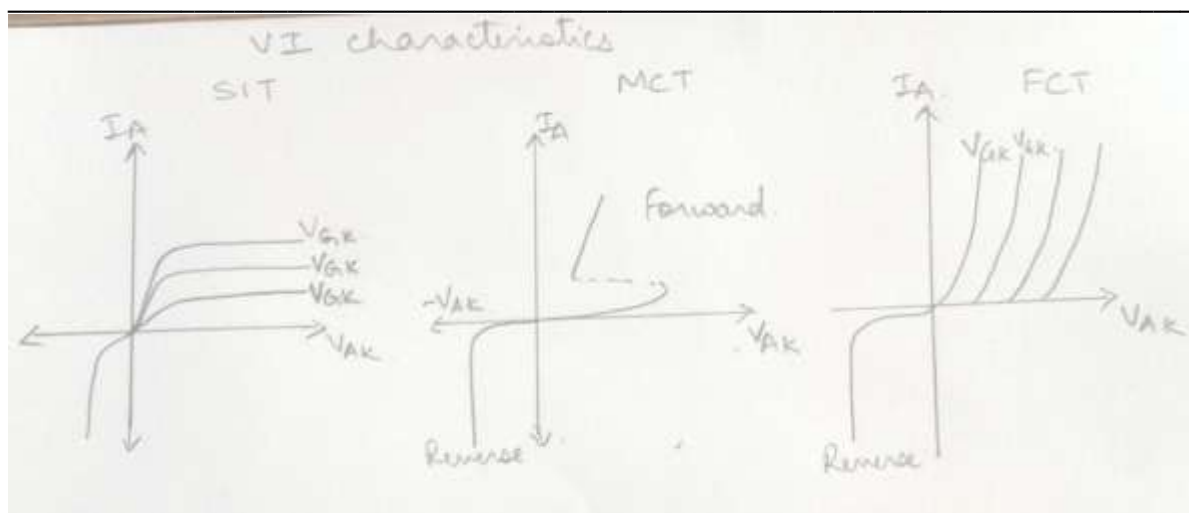


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(ii). What is a chopper? What is the effect of duty cycle an output voltage of a chopper?

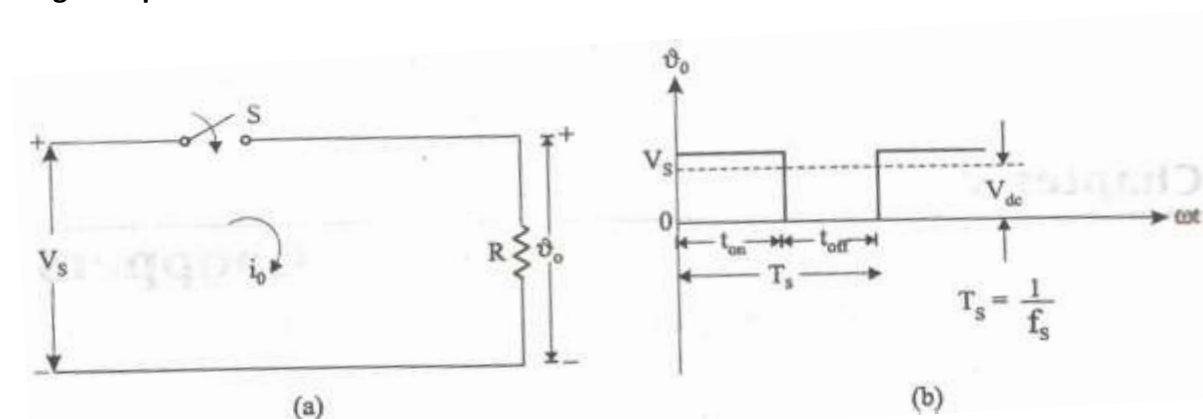
Ans: **Chopper definition: 2 marks and effect of duty cycle: 2marks**

Chopper: - A chopper is a basically a switch which connects and disconnects the load across the DC in put 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



A

basic dc-dc chopper is shown in figure (a). When the switch S is closed the supply voltage V_s 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 T_{on} and the switch-off period T_{off} . Hence the average value, V_{dc} of the output voltage V_o in figure depends on T_{on} and T_{off} . i.e

$$V_o = \frac{T_{on}}{T_{on} + T_{off}} * V_s$$

$$V_o = D.V_s$$

D is called as the duty cycle

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As Ton increases , the output voltage Vo increases.

(iii). With neat diagram explain the principle of resistance welding.

Ans: Operating principle of resistance welding: - [2 marks]

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.

Heat produced is utilized for welding and

$$\text{Heat} = \int I^2 R \, dt$$

Diagram: 2 marks

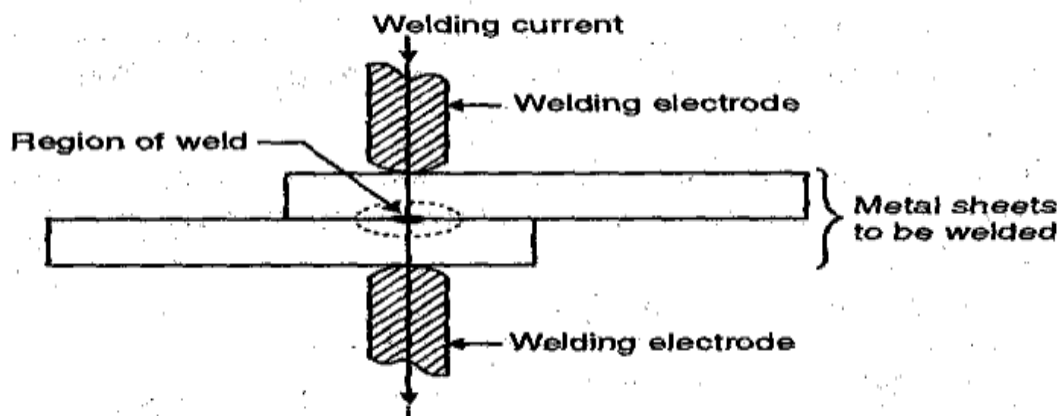


Fig. 8.14.1 : Basic arrangement for resistance welding

(iv) Distinguish between relay type and servo type stabilizers with respect to operating principle, efficiency, distortion and applications.

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	computers

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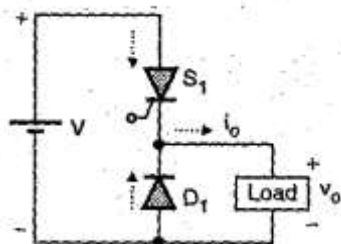
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b) Attempt any ONE of the following:

(i) Describe the working of class A chopper using SCR with circuit diagram. Draw the output waveforms.

Ans: Circuit Diagram- 1 mark

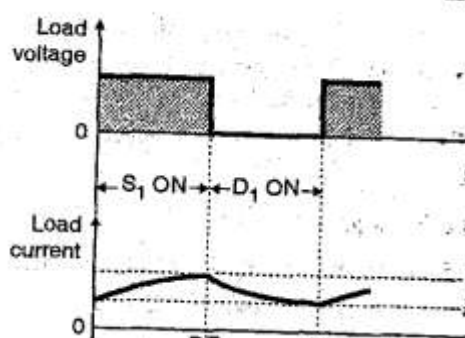


(a) Type A chopper configuration

Explanation-3 marks

1. Type A chopper operates with periodic opening and closing of S_1 .
 2. S_1 and freewheeling diode D_1 conduct only in one direction.
 3. Assume the load is inductive.
 4. When S_1 is closed load voltage is positive, load current is also positive and inductor will store energy. When S_1 is commutated, there is a change in current.
 5. Inductor opposes this change and reverses its polarity.
 6. This forward biases the diode D_1 and freewheeling action takes place.
- Average output voltage and average output current are +ve. Chopper operates in I-quadrant.

Waveforms-2 marks



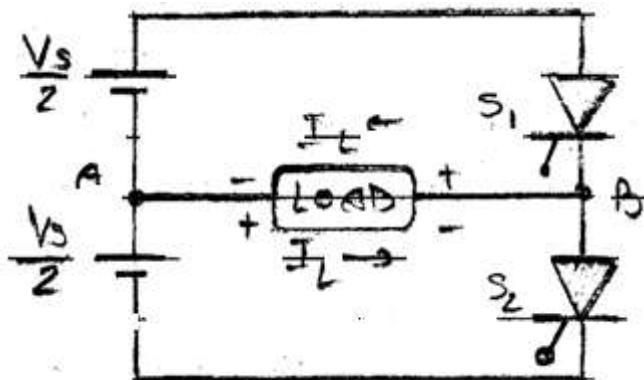
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(ii) Draw the circuit diagram and o/p waveforms and explain the working of half –bridge inverter.

Ans: Circuit Diagram- 1 mark,

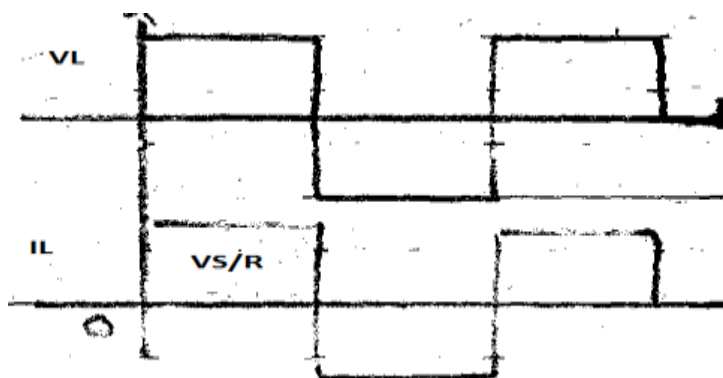


Explanation-3 marks

Assume the load is resistive.

1. When SCR S1 is turned ON, current flows from the upper source, S1 and the load.
2. When SCR S2 is turned ON, current flows from lower half of the source and S2.
3. The direction of the load current reverses across the load.
4. If the load is inductive, then freewheeling diodes are used.

Waveforms: 2 marks



Q2 Attempt any **TWO** of the following:

- 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)

1. The required voltage and current rating are lower than the maximum limits.
2. The designer is forced to use lower rated SCRs for economy and reliability.
3. These lower rated SCRs have to be connected in series and parallel combinations to suit the voltage and current requirements.
4. Series is used for high voltage low current and parallel is used for low voltage and high current applications.

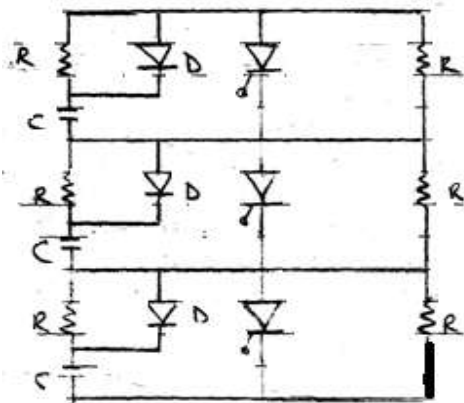
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Diagram-2 marks

STATIC AND DYNAMIC EQUALIZING CIRCUIT



Role of static and dynamic equalizing circuit-4 marks

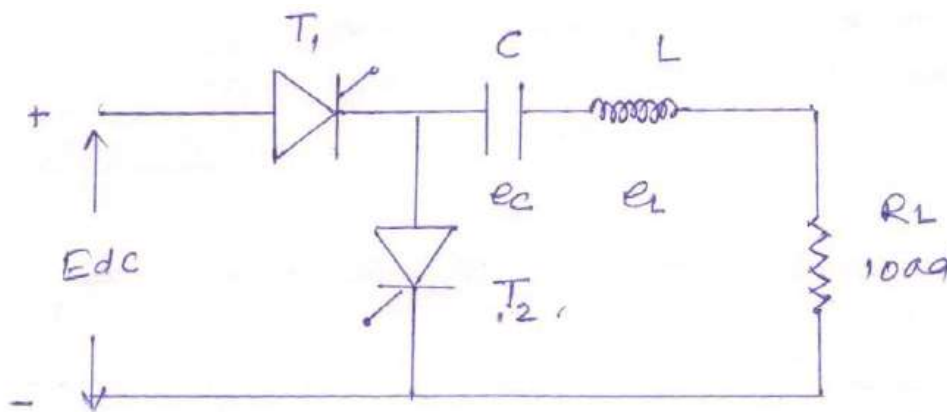
Consider the case of three SCRs connected in series which have different characteristics.

1. 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.
2. 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 i.e. during turn on and turn off of SCRs

- b) Describe the operation of series inverter using SCR's with circuit diagram. Draw the labeled waveforms of load current and output voltage. What are the drawbacks of series inverter?**

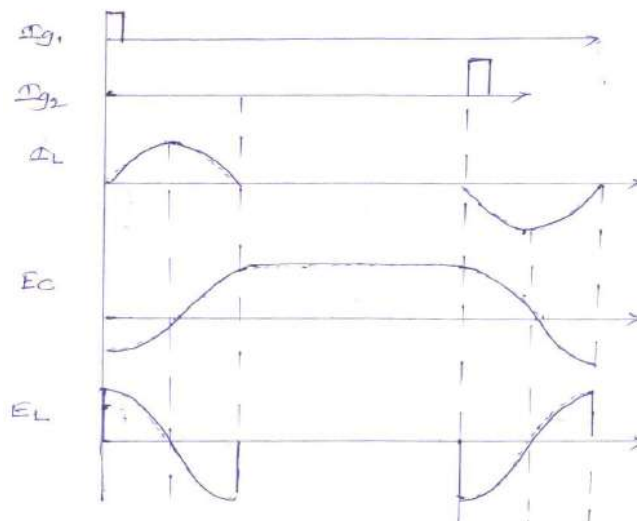
Ans : (Circuit diagram 2M, Working 2 marks, waveform 2marks and drawbacks 2 marks)



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Working:

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 E_{dc} 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.

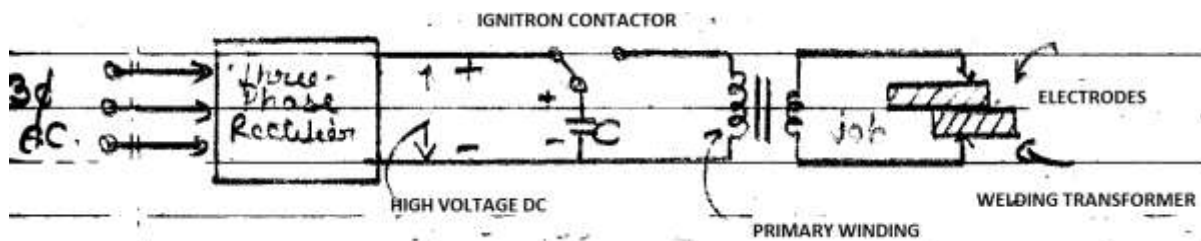
Drawbacks of series inverter

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.

c) Draw and explain the block diagram of capacitor energy storage welding. State the two advantages and two disadvantages.

Ans: (Diagram- 2marks, Explanation- 4 marks, Advantages and Disadvantages- 2 marks)

DIAGRAM-



Explanation-

1. It consists of 3 phase rectifier, ignitron contactor, a large value capacitor connected across primary winding of the welding transformer.
2. The secondary of the welding transformer is connected to 2 electrodes, through which large currents can pass.
3. 3 phase AC is rectified to DC.
4. A step-up transformer is used to increase the voltage if required.
5. Large value capacitor is charged by the DC which stores the energy.

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6. The capacitor discharges the stored energy to the electrodes at the time of welding.
7. Discharging takes place through the primary winding of the transformer.

Advantages: 1. Simple circuit
2. Does not cause voltage dip at the time of welding.

Disadvantages-

1. Large value capacitor is required.
2. 3 phase rectifier is used.

Q3 Attempt any Four of the following:

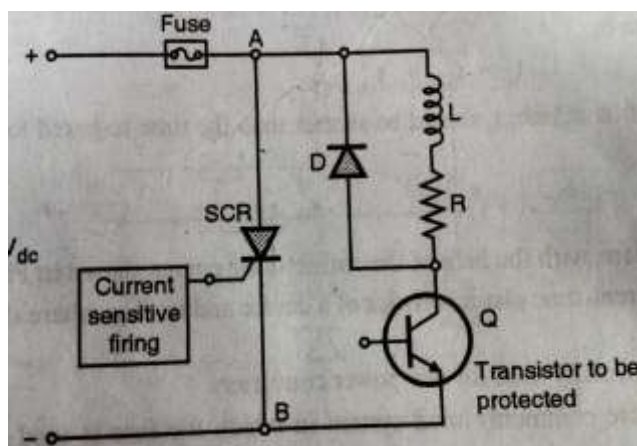
a) Draw and explain the working of crowbar circuit.

Ans: Crowbar protection: (1M)

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

(Diagram 2 marks)



Explanation: 1Mark

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

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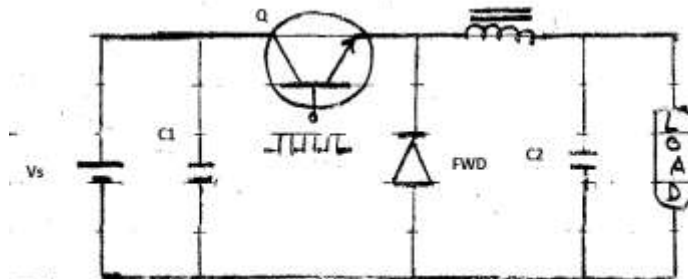
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b) Draw and explain the working of non-isolated SMPS.

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

Buck regulator or Boost regulator can be considered as Non-isolated SMPS

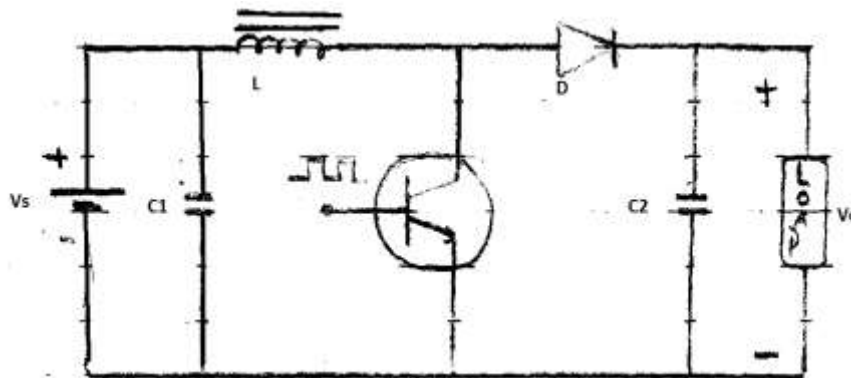


BUCK REGULATOR

BUCK REGULATOR-

1. Transistor Q1 connected in series with the load.
2. When it is turned on the DC voltage is connected to the LC filter.
3. The output is constant with the help of capacitor.
4. When Q1 is off inductor's polarity is reversed, freewheeling diode is forward biased and load current starts flowing through the circuit.

BOOST REGULATOR-



1. It is also a step-up chopper.
2. When Q1 is ON current through the inductor rises, diode becomes reverse biased, load voltage is zero.
3. When Q1 is OFF inductor reverses its polarity, diode becomes forward biased and voltage is available to the load which is more than input voltage.

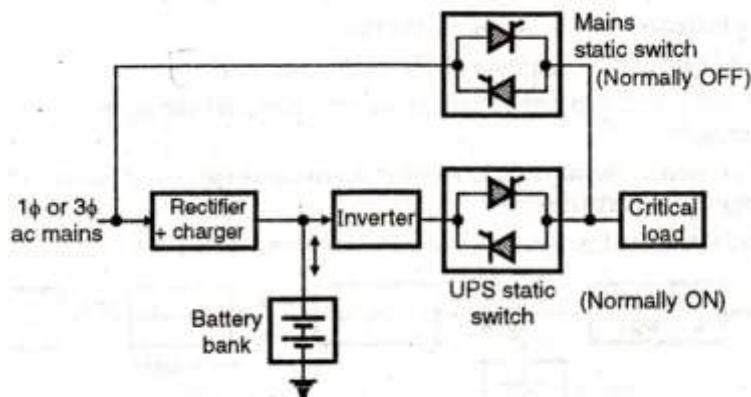
c) Draw the block diagram of ON-LINE UPS and explain the working.

Ans: B.D. of on-line UPS: 02 marks, working: 02 marks

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Working of ON-LINE UPS:

In an on-line UPS, the load is always connected to the inverter through the UPS static switch. The UPS static switch is normally ON and becomes OFF when the UPS fails. In that case mains static switch is ON to connect the load. The static switch consists of anti-parallel connected SCRs.

Mode1 (Mains ON):

1. When the AC mains are ON, the rectifier circuit will supply power to inverter and battery bank.
2. The inverter output is connected to the load through the UPS static switch.
3. The battery will be charged in this mode.

Mode 2 (Main OFF):

1. The AC mains are Off.
2. The rectified output is zero.
3. The battery supplies power to the inverter.
4. The inverter drives the load through the UPS static switch.
5. The battery is in discharging mode.

d) Draw the circuit diagram of synchronous weld control and describe the working of the circuit.

Ans:- DIAGRAM- 2 marks, EXPLANATION- 2marks

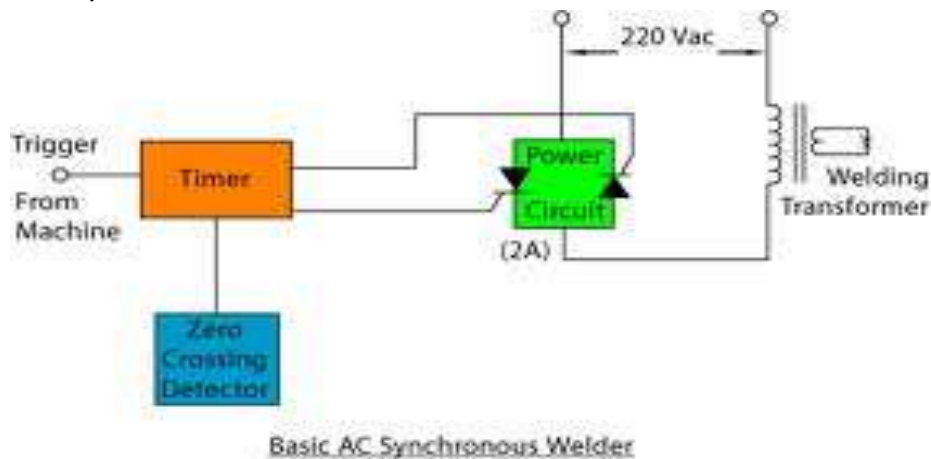
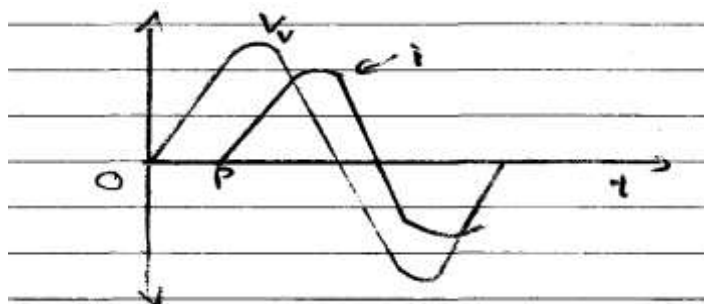


Fig. 2

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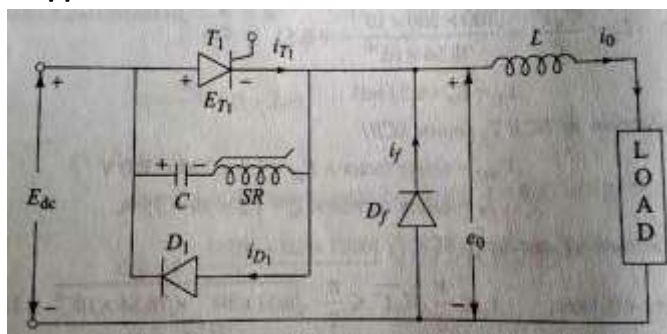
DIAGRAM

WORKING-

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

e) Describe the operation of Morgan's chopper with circuit diagram.

Ans: Diagram of morgan's chopper 2 marks



Explanation 2 marks

1. Initially SCR T1 is in the OFF state.
2. C1 is charged to the supply voltage E_{dc} and the reactor SR is positive saturated.
3. When T1 is triggered, capacitor discharges through T1 and SR.
4. After a short period, charge on the capacitor is reversed and the reactor is negatively saturated.
5. The impedance of the reactor reduces.
6. The reverse voltage of capacitor appears across T1 and turns it off.
- 7.

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Q4. Attempt any THREE of the following:

(i) Describe the operation of single phase cyclo-converter with neat circuit diagram and waveforms.

Ans: Diagram 2 marks (BRIDGE CONFIGURATION)

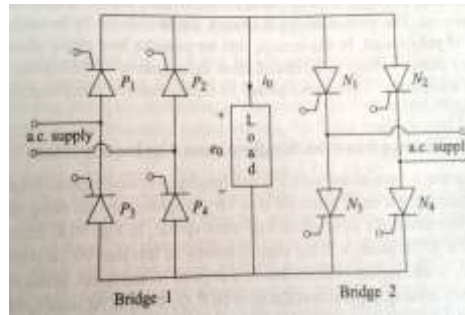
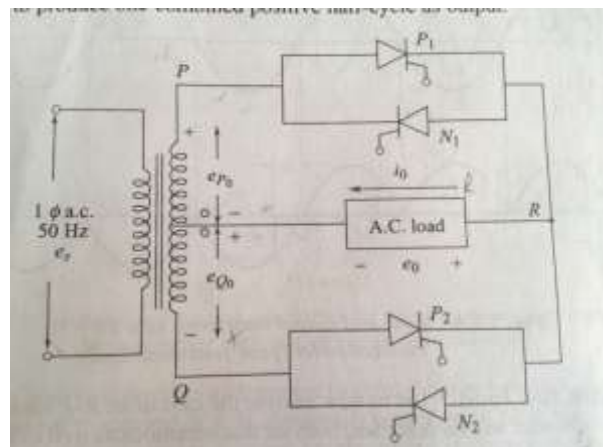
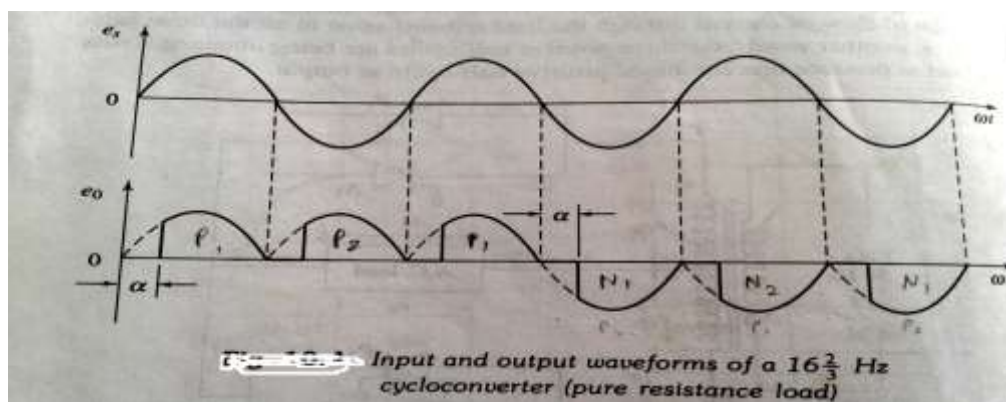


Figure: Bridge configuration of bridge cycloconverter



Waveform:1 mark





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Explanation: 1 mark

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

(ii) What is the need for 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.

Diagram of over voltage and over current protection circuits is optional

Different protection circuits: 2 marks

- **Fuse** and circuit breakers are used for over current protection which are power dependent and have complicated circuit.
- Fuse is connected in series and as fault current increases it melts.
- **Crowbar circuit** can also be used for over current protection
- di/dt protection and dV/dt protection provided by snubber circuit
- **Thyrector selenium diode** or MOV can be used for overvoltage protection which are voltage dependent nonlinear resistors and have simple circuit.
- It senses over voltages due to transients or spikes.
- Over voltage protection devices are selenium diodes and varistors (Varistors).
- Snubber circuits

(iii) Draw the circuit of Relay type voltage stabilizer and explain the working.

Ans) Diagram :- (02 marks)

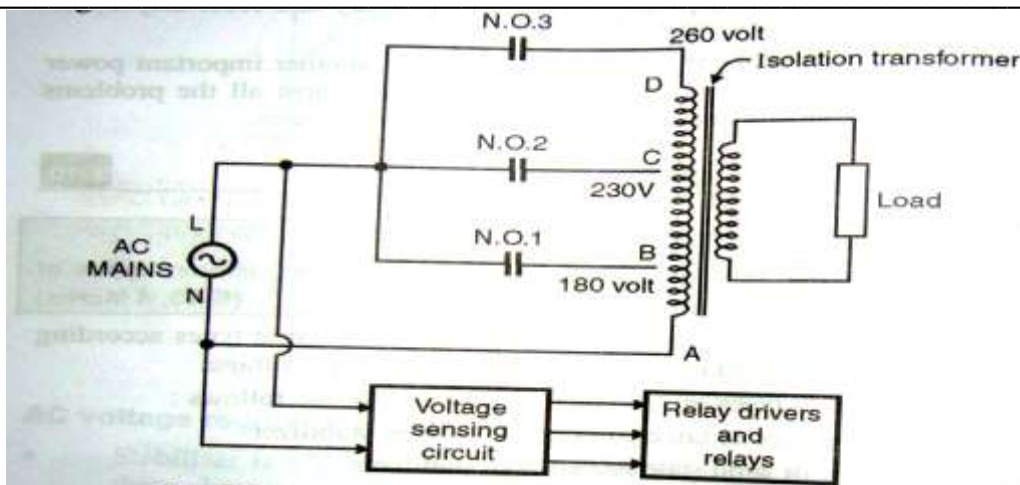
Relay type AC voltage stabilizer:-

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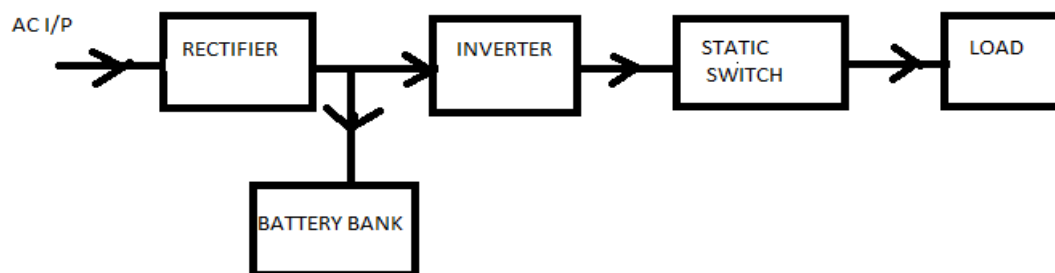
Working: 2 marks

1. The primary winding is divided into several taps.
2. End A of transformer is connected to neutral.
3. 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.
4. The voltage sensing circuit senses the input voltage and the relay driver circuit operates the relay.
5. If there is an over voltage, say 260 V, NO3 will be closed and the output voltage will be reduced.
6. If there is an under voltage, say 180 V, NO1 will be closed and the output voltage will be increased.
7. Output is discontinuous control type and not suitable for critical load.

(iv) Draw the basic block diagram of UPS. List the specifications of UPS.

Ans: Diagram 2 marks and any 4 specifications 2 marks

Block diagram of UPS 2 marks



Various specification of UPS :

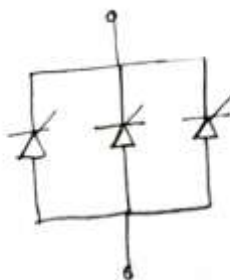
- i) Power rating
- ii) Output voltage
- iii) Output frequency
- iv) Output waveform
- v) Input voltage
- vi) Backup time
- vii) Transfer time
- viii) Efficiency of the current
- ix) Protection provide
- x) Load power factor

b) Attempt any ONE of the following:

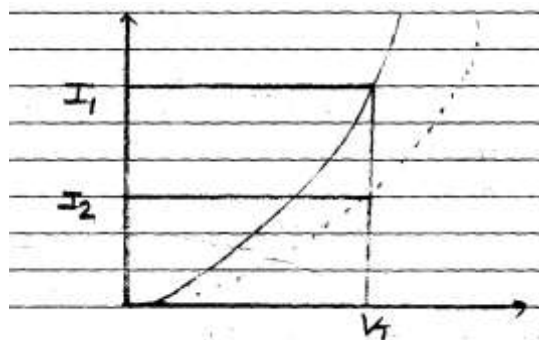
(i) Draw the circuit diagram of parallel connections of three thyristors and describe with forward characteristics. Justify symmetrical arrangement of SCR's.

Ans: (Parallel connection- 1 mark, Forward characteristics- 1 mark, symmetrical arrangement- 1 mark, explanation- 3 marks)

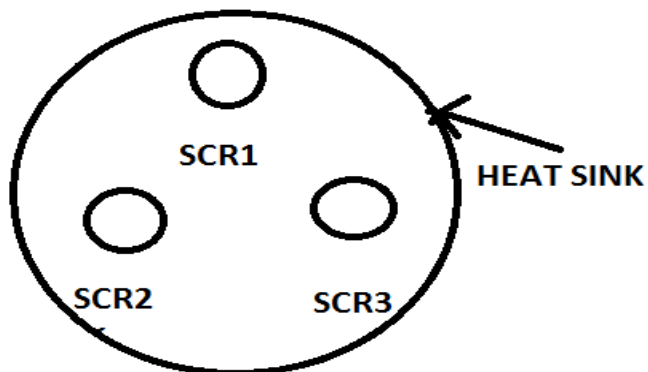
Parallel connection of SCRs-1 mark



FORWARD CHARACTERISTICS-(1 MARK)



SYMMETRICAL ARRANGEMENT- (1 MARK)



EXPLANATION-

1. SCRs are connected in parallel to improve the current rating.
2. Due to unequal dynamic resistance the sharing of current will not be equal which causes heating of the SCRs and thermal runaway.

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3. Hence, all the SCRs operated in parallel should be at the same temperature by having a common heat sink.
4. When operated in parallel there is a problem of unequal flux linkages.
5. SCR which is in the centre will have maximum flux and will share less current. In case of linear mounting.
6. Hence symmetrical arrangement of SCRs is used which provides equal flux linkage.

(ii). With neat waveforms describe how output voltage and harmonics can be controlled using PWM control method in inverters.

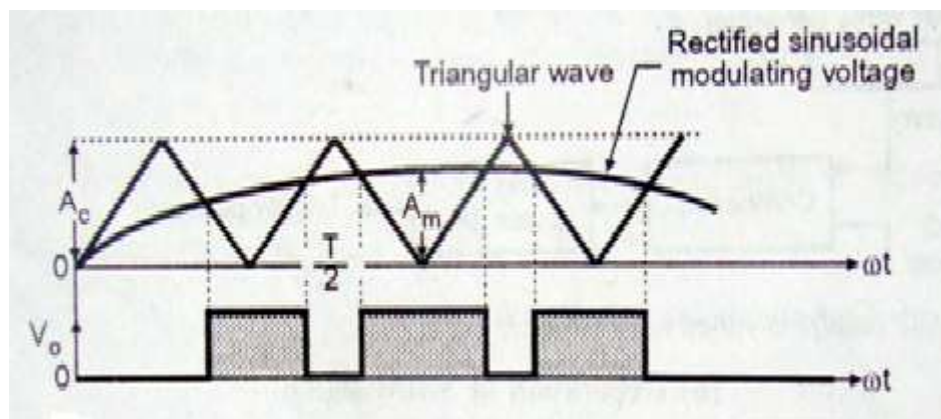
Ans:-

Note:- Any one method can be considered with diagram 2 marks and explanation 4 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) Single pulse width modulation
- 2) Sinusoidal pulse width modulation
- 3) Multiple pulse width modulation

Sinusoidal pulse width modulation : 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 A_m and frequency $f_m = 1/T$ 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: A_m / A_c . The carrier frequency ratio is defined as the ratio of f_c to f_m .



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.

Types of pulse width modulation:

- 1) **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.



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The gating signals are generated by comparing a rectangular reference signal of amplitude A_r with a triangular carrier wave of amplitude A_c .

2) 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. $f_c > f_m$

3) Sinusoidal Pulse-Width Modulation

Instead of maintaining the width of all pulses the same as in the case of multiple-pulse modulation, the width of each pulse is varied in proportion to the amplitude of a sine wave. The gating signals are generated by comparing a sinusoidal reference signal with a triangular carrier wave of frequency f_c .

The six-step waveform has a zero-voltage step between the positive and negative sections of the square wave such that the harmonics that are multiples of three are eliminated. When carrier-based PWM techniques are applied to six-step waveforms, the basic overall shape, or envelope, of the waveform is retained so that the 3rd harmonic and its multiples are cancelled.

Q5) Attempt Any TWO of the following:

- a) Draw and explain the working of Jone's chopper with neat circuit diagram and waveforms.

Ans) **(Explanation 02 M, Circuit 03M, Waveforms 03M)**

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. $V_o = V_i$ 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 commute main SCR T1.

When auxiliary SCR T2 is triggered. The Capacitor C gets effectively connected across T1. This reverse biases the SCR T1, and turn it off. $V_o = 0$ 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 $i_L = i_{T2}$ 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 cease, and the circuit is 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.

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Circuit diagram:-

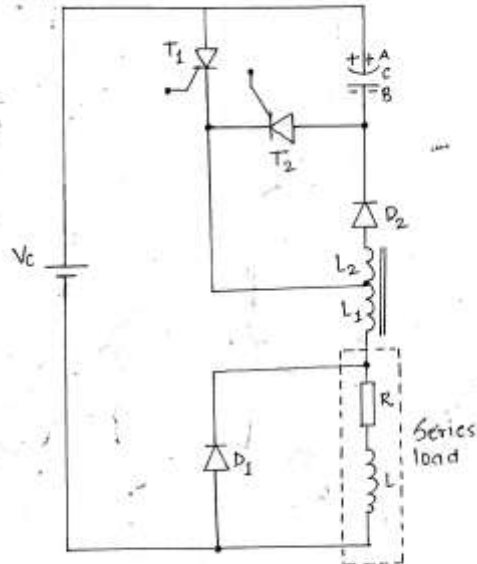


Fig: Circuit diagram of Jones's Chopper

Waveform:-

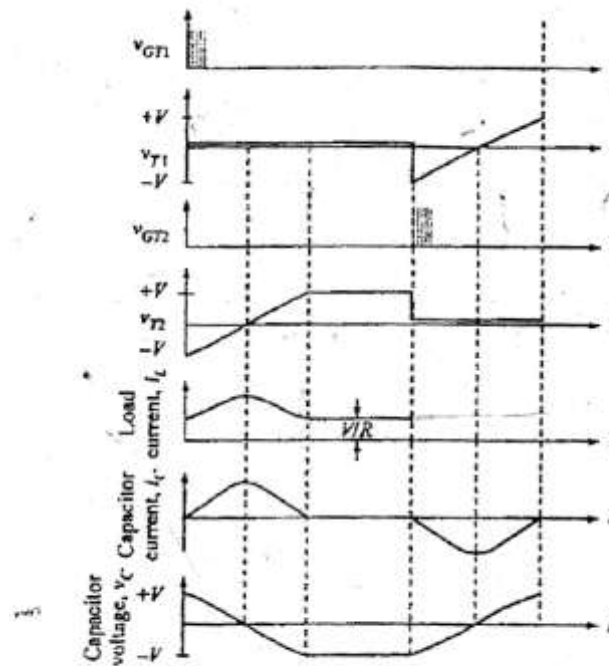


Fig 2.12 Voltage, Current waveform of Jones's Chopper

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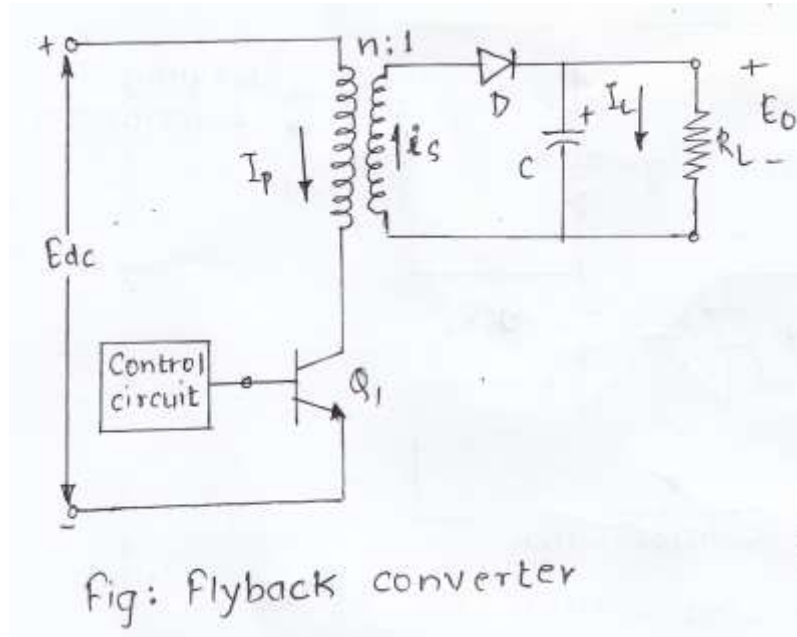
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b) Explain the principle and operation of isolated SMPS. State two advantages and disadvantages.

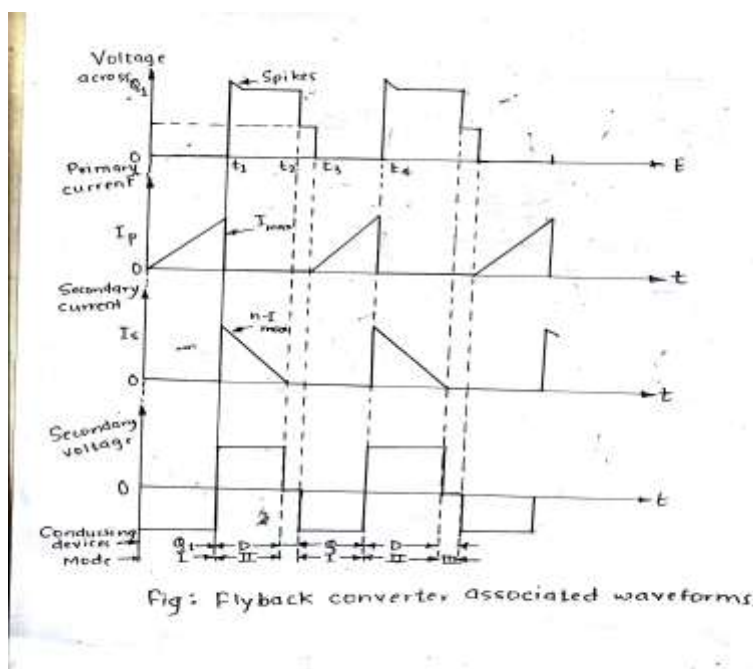
Ans) (Principle & Operation 04M, Advantage 02M, Disadvantage 02M)

(Note:- Marks should be credited for answer of any type of isolated SMPS)

Circuit Diagram:-



Waveform:-





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Mode I(t_0-t_1) :

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 $t=t_1$. The equivalent circuit for this mode is shown in figure

Mode II(t_1-t_2):

When the transistor is turned off at $t=t_1$, 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 I_L to load. The voltage across Q1 is the sum of input supply voltage (E_{dc}) and the self induced voltage across the primary winding ($L \frac{di}{dt}$), therefore it is higher than the supply voltage (E_{dc}). The equivalent circuit for this mode is shown in figure. The secondary current goes to zero at $t=t_2$. Thus the stored energy in the transformer core is delivered to load during this mode of operation.

Mode III(t_2-t_3):

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 (E_{dc}). The secondary voltage is zero. The one cycle operation completes in this mode and repeats itself.

Advantages : (any 2)

1. Slower diodes can be used on the secondary side for rectification
2. Size of transformer is smaller than that in the continuous mode
3. Fast Transient response
4. An additional filter inductance is not required on the secondary side

Disadvantage: (any 2)

1. Peak current rating of both devices is high
2. Large size filter capacitor is required
3. The maximum value of duty cycle is limited to 50% to avoid core saturation

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c) Draw and explain the working of parallel inverter using SCRs with circuit diagram and O/p voltage and load current waveforms.

Ans) (explanation 02M, Circuit 03 M, Waveform 03M)

Parallel Inverter using SCR:-

In the parallel inverter the commutating component are connected in parallel with the load, where a capacitor connected in parallel with the load is used to commutate a conducting thyristor by applying reverse voltage across the thyristor. An inductor L is required in series with the dc source to prevent the instant discharging of capacitor C via the source when the thyristor switching occurs.

Figure show the basic parallel inverter circuit. This circuit can produce ac square wave output from dc source.

Circuit Diagram:-

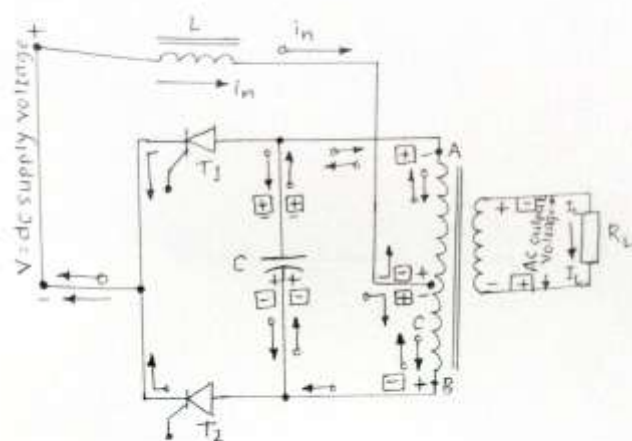


Fig : Parallel inverter

Waveform:-

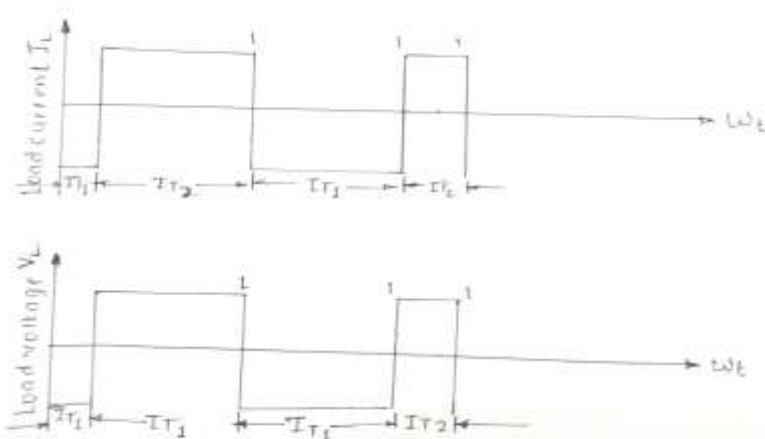


Fig : Waveform of parallel inverter

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Explanation:-

When T1 is fired and current flows through the inductance L and thyristor T1, the d.c source voltage E_{dc} appears across half the transformer primary which means the total primary voltage is $2E_{dc}$ hence the capacitor is charged to $2E_{dc}$ with the polarity shown in figure.

When T2 is turn on the commutating capacitor applies a voltage $-2E_{dc}$ to appear across T1. When this reverse voltage is applied for sufficient time across T1, it will be turn off. SCR T2 will now be conducting and a voltage of $2E_{dc}$ will appear across the transformer primary and the commutating capacitor, but with a reverse polarity.

When T1 is turned on the commutating capacitor applies a voltage $-2E_{dc}$ to appear across T2, hence it will turn off. Thus, if trigger pulses are periodically applied to the alternate thyristors, an approximately rectangular voltage waveform will be obtained at the transformer output terminals

Q6.) Attempt any Four of the following:

- a) Draw the equivalent circuit of MCT and explain the working.

Ans) (Circuit diagram 02 M, Explanation 02M)

Circuit Diagram:- MCT could be NMCT or PMCT

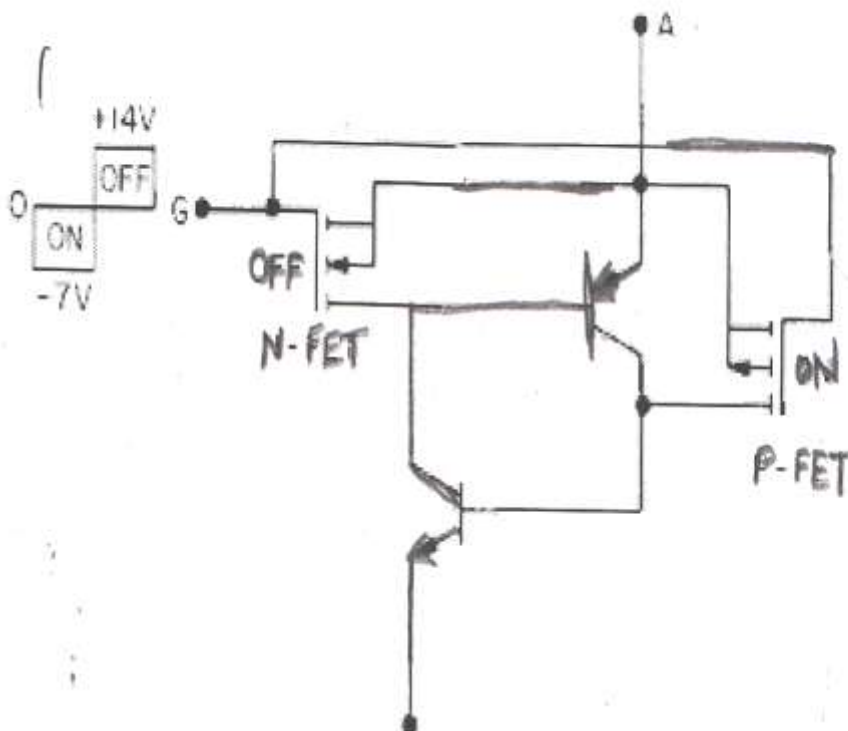


Fig: circuit diagram of MCT

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MCT turn ON:

If the gate of the MCT is negative with respect to anode a p-channel is created in p-FET and p-channel ON FET causes the forward biasing of n-p-n transistor.(base drive to n-p-n transistor), the n-p-n transistor applies base drive to p-n-p transistor and regenerative action starts and the device is latched(turns ON).

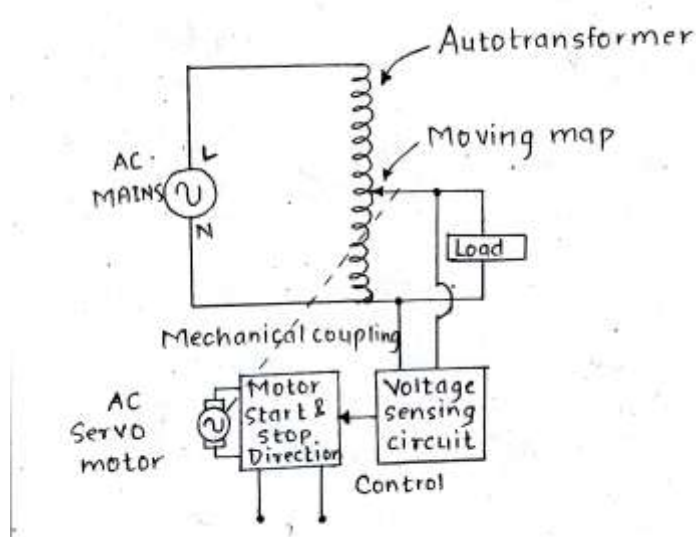
MCT turn OFF :

If the gate of MCT is positive with respect to anode, turn off the ON FET and n-channel is created in n-FET and n-channel FET turns ON which short circuit the base emitter junction of p-n-p transistor, this diverts the base drive of the transistor through OFF FET and breaks the regenerative process and the device will turn off.

b) Draw and explain the working of servo type voltage stabilizer.

Ans) (Explanation 02M, Diagram 02M)

Diagram:-



Above figure shows the servo-type stabilizer. As seen from the figure it uses an ac servomotor which is mechanically coupled to the moving tap of an autotransformer. The sensing circuit will sense the load voltage, if it is found to be less than or greater than the normal voltage i.e 230v, it will rotate the ac servomotor in either clockwise or anticlockwise direction. This will rotate the moving tap of the autotransformer and the necessary corrective action is completed.

ADVANTAGES:-

1. Smooth step less variation in the output voltage.
2. Good voltage regulation
3. Output voltage waveform is undistorted

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Disadvantages:-

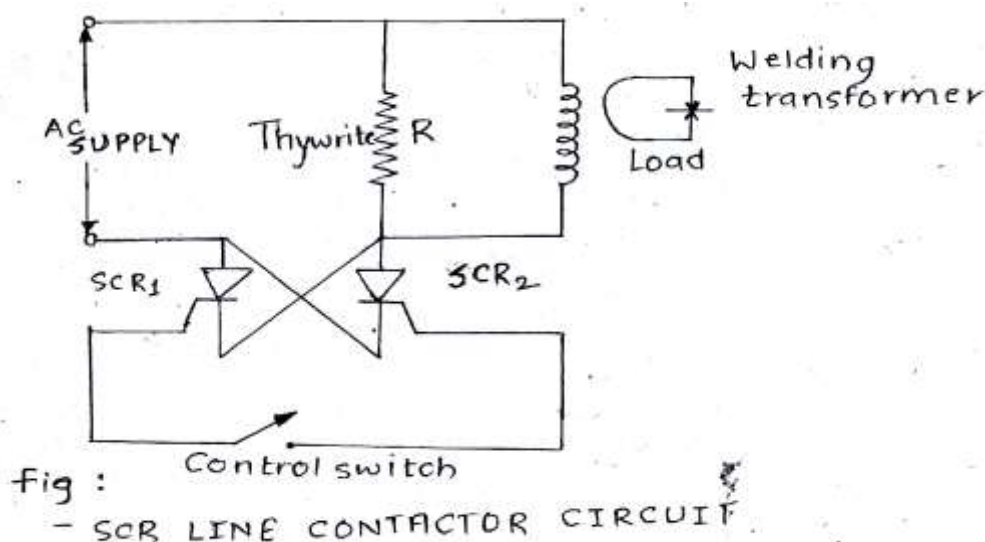
1. Due to the use of autotransformer and ac servomotor circuit is costly
2. It is not very fast in action

Application:-

1. Mostly for computers
- c) Draw neat labeled diagram of line contactor using SCR and explain the working?

Ans) (Diagram 02M, Explanation 02M)

Diagram:-



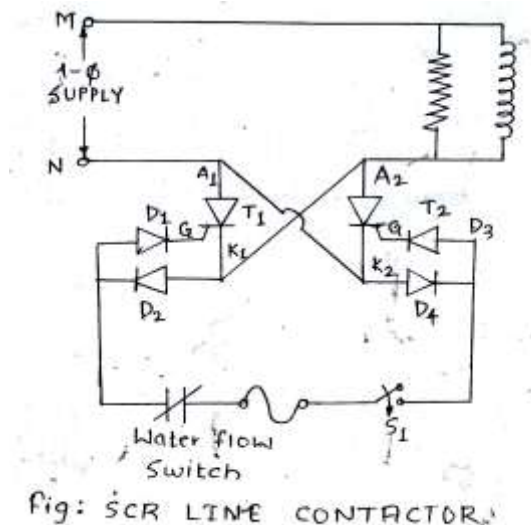
Line contactor is an electronic switch, which can connect or disconnect AC supply to the welding transformer primary at the time of welding. Two SCR's are used and connected in inverse parallel one to pass current during the positive half cycle and the other during the negative half cycle. When SCR's are connected as shown in fig. and used in resistance welding controllers SCR's are typically called a contactor or A.C switch. While the efficiency of the SCR is very high, when conducting current, there is a problem of losses that produce heat. Excessive heat is one cause of damage of SCR's, therefore they must be operated below damage temperature, maximum junction temperature of typical SCR's used for resistance welding are below 135°C . since SCR's are used to control high currents, they can heat up and exceed the maximum junction temperature within millisecond.

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The two SCR's T1 & T2 are line contactors. During negative half cycle the SCR circuit carries current via negative supply N-A₁-K₂-S₁-Fuse-D₁-K₁-A₂-transformer-M, when the circuit is complete, gate current fires SCR T1 & it becomes 'on'. The main current now flows through SCR T1 and then through the welding transformer. Similarly during positive half cycle, SCR current flows M-transformer-A₂-K₁-D₂-Fuse-S₁-D₃-K₂-A₁-N. This makes SCR T2 to 'ON' & current flows through Anode to Cathode. Whenever the SCR fires, welding current flows in secondary circuit, but here the control is done manually. In circuits requiring heat control, the firing of SCR is done by phase-shift bridge network.

d) Define the battery parameters : Back up time & Transfer time.

Ans)

Back up time : (2marks)

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

Transfer time : (2marks)

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

e) What is snubber circuit ? List the types of snubber circuits and draw the circuit diagram of any one type.

Ans: (definition 01M, List the Types 01M, Diagram 02M)

Snubber Circuit:-

A snubber is a device 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/dt across thyristor, limit di/dt and over voltage during turn on and off.

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Types of snubber circuit :

- 1) RC snubber
 - i) Polarized
 - ii) Unpolarized.
- 2) Polarized snubber
 - i) Forward polarized
 - ii) Reverse polarized

Diagram:- (Any one)

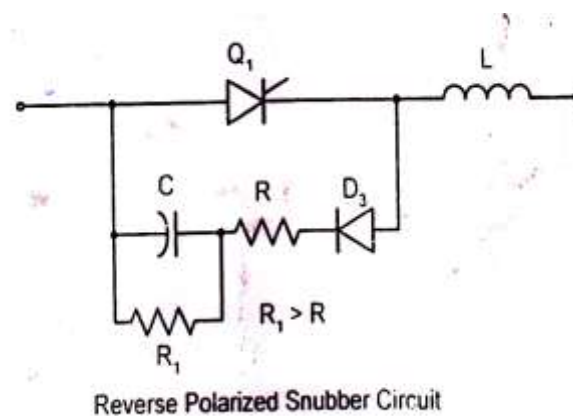


Figure: Reverse Polarized snubber circuit

OR

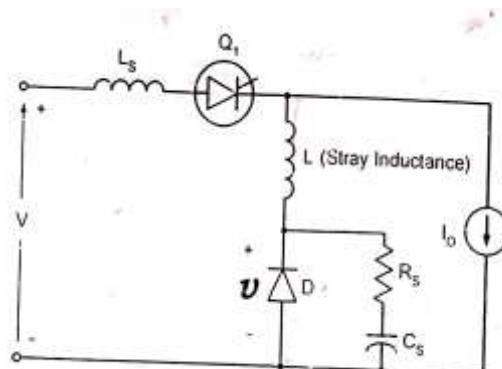


Figure: D type snubber circuit

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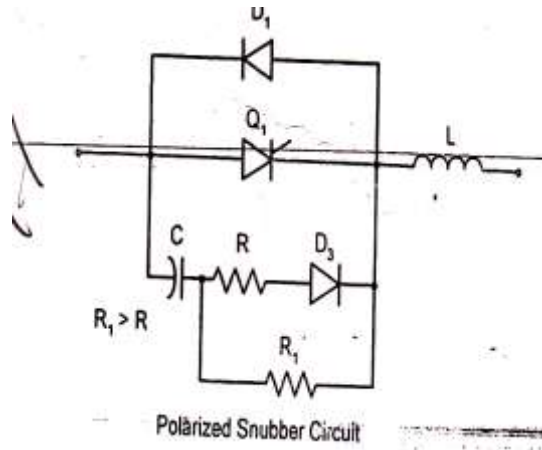


Figure: Polarized snubber circuit

OR

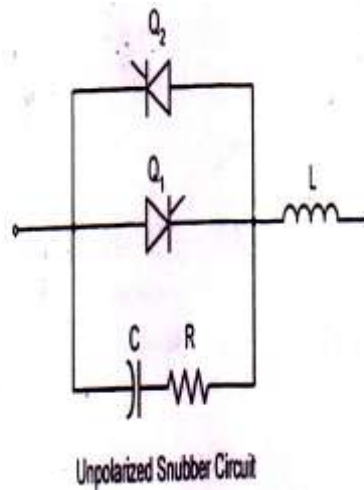


Figure: Unpolarized Snubber Circuit