Summer 2015 Examination

Subject Code: **17444** **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 model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q 1. (A) Answer any SIX: Marks 12

(a) Define Holding current and Latching current for SCR.

Ans: (Each definition for 1mks.)

(i) Holding current : It is the minimum anode current required to hold the SCR in the ON state. When the anode current goes below the holding current, the device will go to OFF state.

(ii) Latching current : It is the minimum anode current required to maintain the SCR in the conduction state, even when the gate signal has been removed.

(b) List four regions in characteristics of power transistor.

Answer: (Each region for ½ M.)

Four regions in characteristics of power transistor are :

i) Cutoff region

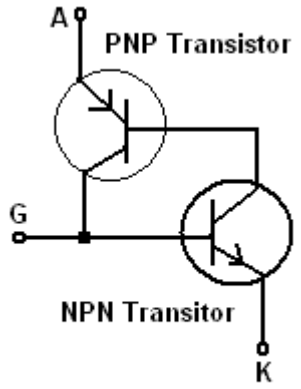
ii) Active region

iii) Quasi saturation

iv) Hard saturation

(c) Draw two transistor equivalent circuit of SCR & label it .

Ans: (For circuit diagram 2M.)



SCR Equivalent Circuit

(d) Define : (1) Chopper (2) Inverter

Ans: (Each definition for 1M.)

Definitions

1) Chopper: Chopper is a circuit which converts fixed d.c. voltage into variable d.c. output voltage.

2) Inverter : Inverter is a circuit which converts d.c. power into a.c. power at desired output voltage and frequency.

(e) Define commutation .What is meaning of natural commutation ?

Ans: (Definition for 1M, Brief explanation of natural commutation 1 M)

Commutation: The process to turn off conducting SCR is called commutation.

Natural commutation: It is the commutation in which the current through the SCR decreases below holding current naturally.

e.g. In A.C. circuits there is natural zero value of current at the end of each cycle. Therefore in A.C. circuits, current through the SCR naturally decreases below the holding current.

(f) List two applications of choppers.

Ans :(Any two applications for 2 M.)

Applications of chopper are :
1. Battery driven vehicle 2. SMPS
3. DC drives 4. Electric traction

(g) State advantages of controlled rectifier over uncontrolled rectifier.

Ans : (Any two advantages for 2M.)

Advantages of controlled rectifier over uncontrolled rectifier:

i) Average DC output voltage can be controlled or varied.

ii) Suitable for high and medium current and voltage ratings.

h) What is function of timer?

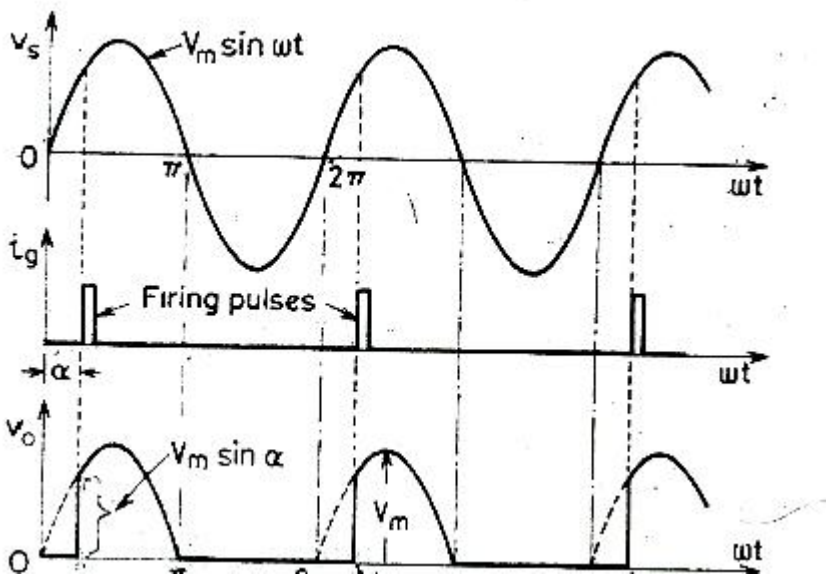
Ans: (Explanation for 2M.)

Timers are time delay relay, which provide a delayed switching action between the time an event is initiated and the event is actually performed.

(B) Answer any TWO **Marks 8**

(a) Explain how DC voltage is varied in single phase half wave controlled rectifier with resistive load.

Ans: (Waveform for 2M.Explanation for 2M.)



In single phase controlled rectifier , average DC output voltage is given by

$V_{dc} = \frac{V_m}{2\pi}(1 + COS\alpha)$

By varying the firing angle (α) of SCR DC voltage can be varied single phase controlled rectifier. As firing angle (α) increases, DC output voltage decreases. Following shows DC output voltage waveform at different firing angle.

(b) Give classification of choppers on the basis of input , output voltage level and directions of output voltage current.

Ans: (Each classification point for 2M.)

Choppers are classified as:

1. On the basis of input /output voltage level:

(i) Step-up chopper.

(ii) Step-down chopper.

2. On the basis of the direction of output voltage and current :

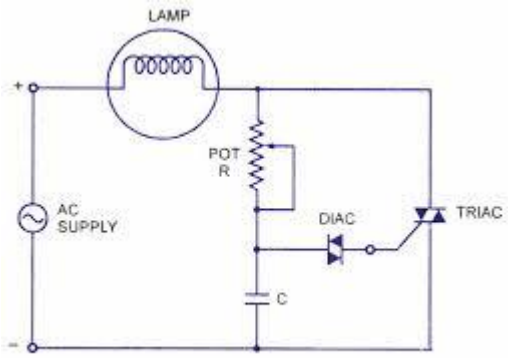
(i) Class A, (ii) Class B, (iii) Class C, (iv) Class D, (v) Class E.

(c) It is desirable in a LDR based application in industry to change intensity of light falling on it. Suggest a electronic circuit and explain its working with appropriate circuit diagram.

Ans (Circuit identification 1M., Circuit Diagram 2M., Brief Explanation 1M.)

To change intensity of light falling on LDR, one can use **Light dimmer circuit .**

Circuit Diagram of light dimmer using TRIAC and DIAC as follows**:**



Triac Lamp Dimmer Circuit

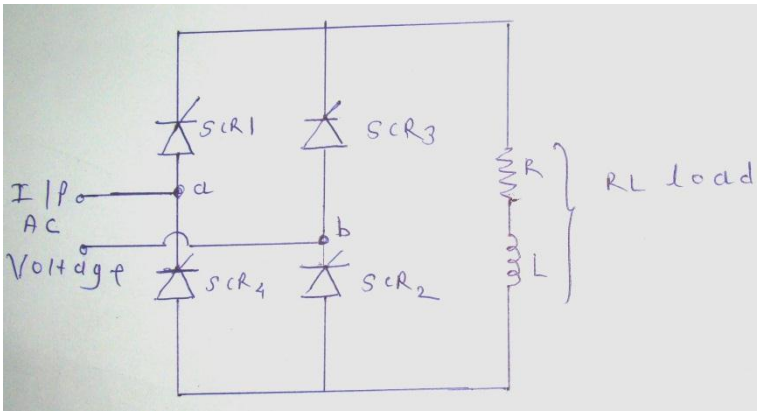
Working : In the above circuit, DIAC is used to trigger TRIAC.
During the positive half cycle the TRIAC requires a positive gate signal for turning it ON. This is provided by the capacitor C. When the voltage across capacitor is above the breakdown voltage of the DIAC, DIAC turns ON and the capacitor discharge through the TRIAC gate i.e. positive gate signal is given to the TRIAC and thus TRIAC turns ON. So current starts flowing through load.
A similar operation takes place in the negative half cycle and a negative gate pulse will be applied when the DIAC breaks down in the reverse direction. The charging rate of capacitor C can be changed by varying the resistance R and hence the firing angle can be controlled.
Thus if firing angle is less, light intensity of lamp is more and if firing angle is more, light intensity of lamp less. Thus by changing value of POT R light intensity cab be varied.

Q.2 Answer any FOUR: Marks 16

(a) Draw single phase controlled bridge rectifier with R-L load and explain its working .Draw i/p, o/p voltage & current waveforms.

Ans: (Circuit Diagram 2 M , Waveforms 1M, Explanation 1 M.)

Circuit Diagram and Waveforms as follows:



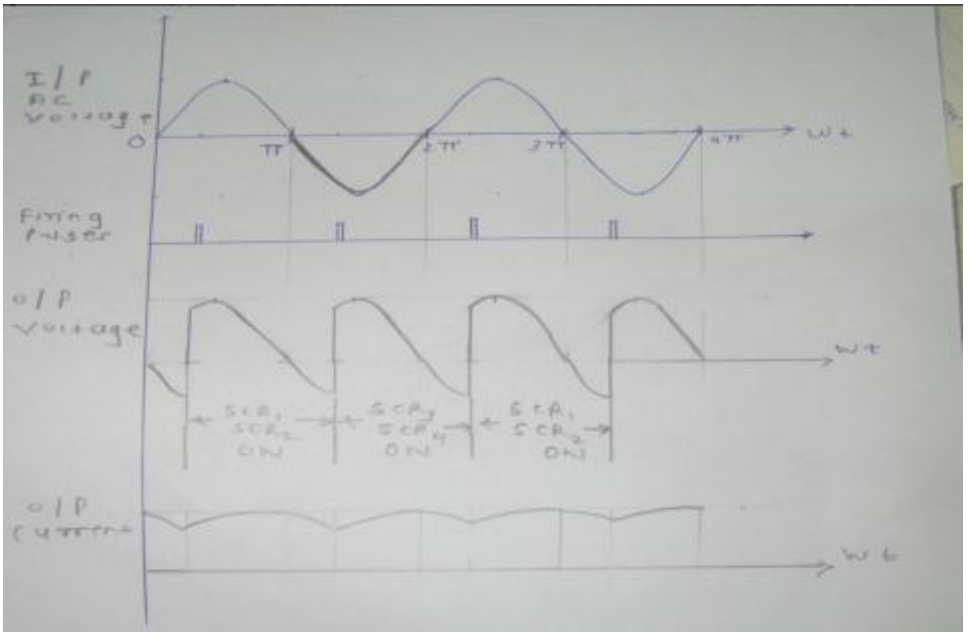
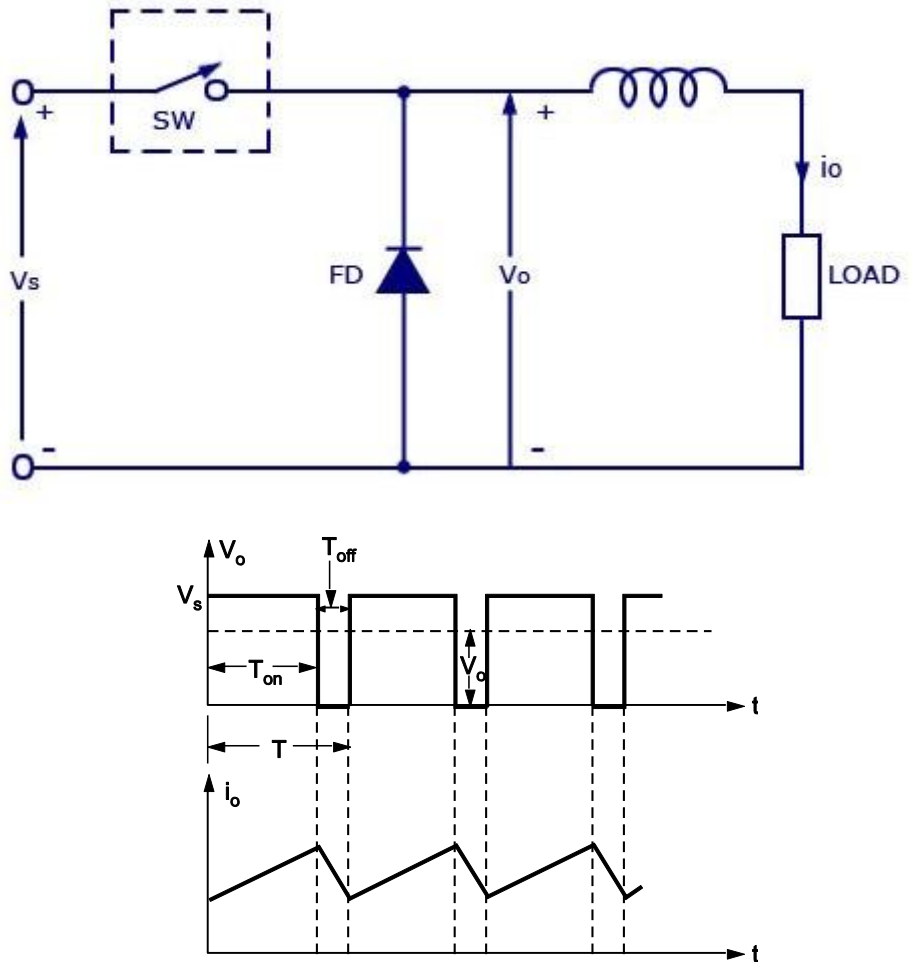


Figure shows circuit diagram of single Phase fully controlled bridge rectifier with R-L load
1) During positive half cycle of AC input voltage SCR 1 and SCR 2 are in forward biased condition When firing pulses are applied at the gate of SCR 1 and SCR 2 ,At $\omega t = \alpha$ they conducts and load current flows through the path pt a – SCR 1 – load -SCR 2 – pt b. At $\omega t = \pi$, as input cycle changes its polarity SCR 1 and SCR 2 should turn off but due to R- L load they continue to conduct in the negative half cycle also.
2) During negative half cycle of AC input voltage SCR 3 and SCR 4 are in forward bias condition so when they are fired at $wt = \pi + \alpha$,they start conducting and SCR 1 and SCR 2 turns off and SCR 3 and SCR 4 continue to conduct upto $\omega t = 2\pi + \alpha$ and the load current flows through the path point b – SCR 3 –load –SCR 4 - point a , and the sequence repeats.

(b) Explain operation of step-down chopper with waveforms for output voltage and current.

Ans: (Circuit Diagram 2 M, Waveforms 1M, Explanation 1 M.)

Circuit Diagram and waveform of step-down chopper:



Operation: When chopper switch is ON, the load is connected to the supply V, and inductor stores energy during ON-period t_{on}. When the chopper switch is OFF, due to self induced voltage of inductor diode becomes forward biased and load current is forward to flow through the diode and load and hence load voltage becomes zero for a period t_{off}.

Average output voltage = $V_o = V_s \times D$

where V_s = DC input voltage and $D = \frac{T_{on}}{(T_{on} + T_{off})}$ called duty cycle.

D can be varied from 0 to 1 and the output voltage can be varied from 0 to V_s volts .

(c) Compare ON line and OFF line UPS w.r.t. following points :

(1) Nature of output

(2) Transfer time

(3) Condition of mains static switch

(4) Condition of UPS static switch

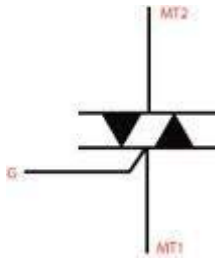
Ans: (Each comparison point for 1M.)

Paramerter	ON line UPS	OFF line UPS
Nature of output	230 Volts AC.	230 Volts AC.
Transfer time	Less	More
Condition of main static switch	Normally OFF	Normally ON
Condition of UPS static switch	Normally ON	Normally OFF

(d) Draw symbol of TRIAC. It can be operated in how many modes? Which mode is sensitive?

Ans: (Symbol 1M. , Operating modes 2 M. , Sensitive mode 1M.)

Symbol of TRIAC



TRIAC can operate in following four modes:

i) Mode 1 : MT2 positive w.r.t.MT1 and gate current positive

ii)Mode 2 : MT2 positive w.r.t.MT1 and gate current negative

iii)Mode 3 : MT2 negative w.r.t.MT1 and gate current negative

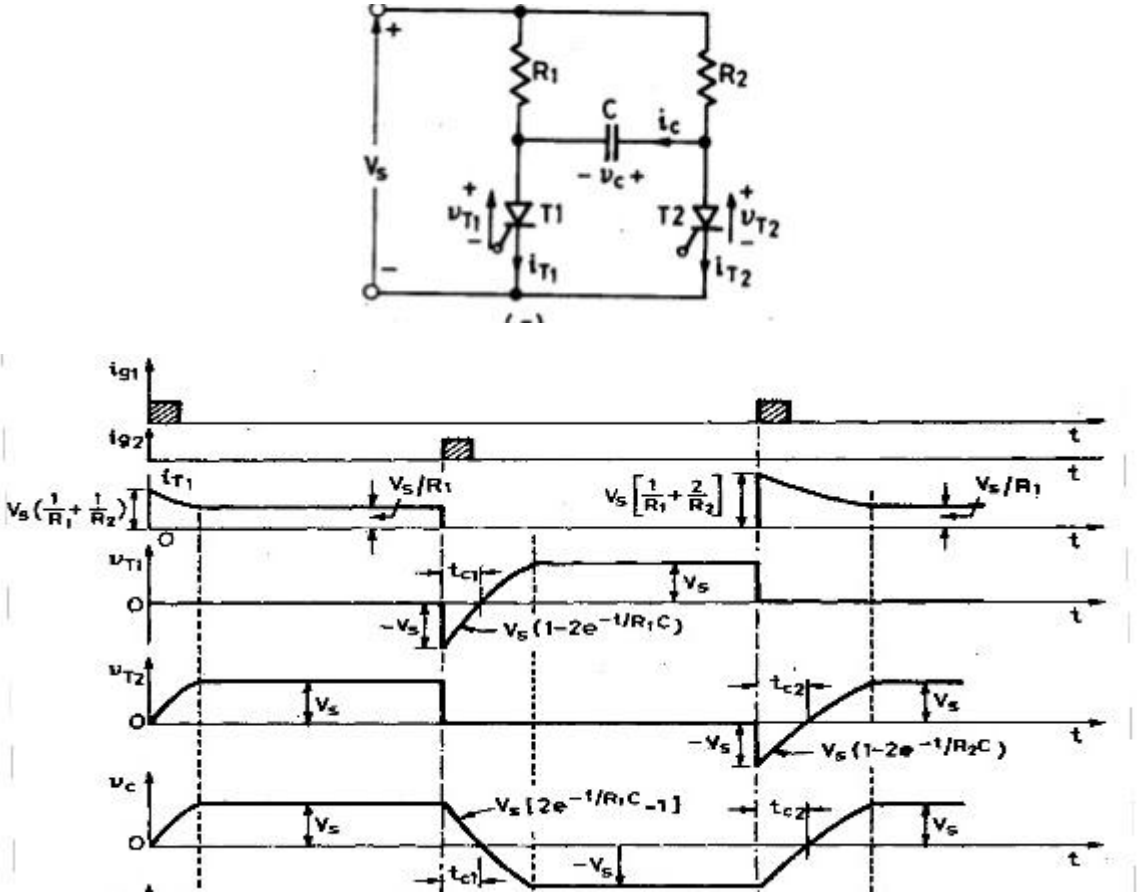
iv)Mode 4 : MT2 negative w.r.t.MT1 and gate current positive

Out of these all modes TRIAC is more sensitive in mode 1 i.e. MT2 positive w.r.t.MT1 and gate current positive and mode 3 MT2 negative w.r.t MT1 gate negative.

(e) Explain operation of class-C commutation with neat sketch and output load voltage & current waveforms.

Ans: (Circuit Diagram 2 M, Waveforms 1M, Explanation 1 M.)

Following shows Circuit diagram and waveforms of Class C commutation:



Class C commutation is also called complementary commutation because triggering of one SCR turns OFF the other SCR.

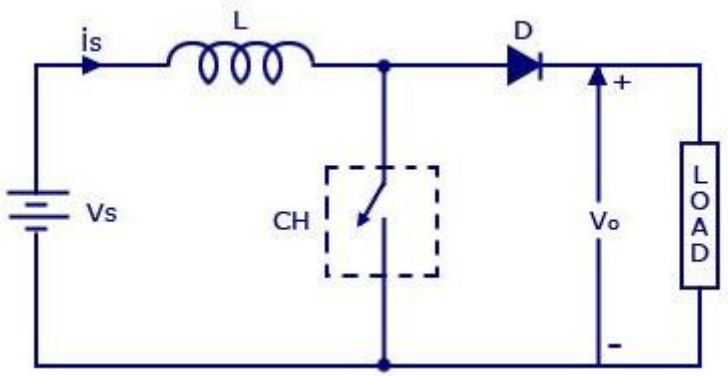
Operation: 1.Suppose SCR_2 is triggered then it starts conducting, then capacitor C charges upto supply voltage V_s. When SCR_1 is triggered, capacitor connects reverse voltage across SCR_2 and it turns OFF.

2. Now SCR_1 is conducting, hence capacitor charges upto supply voltage in opposite polarity. When SCR_2 is triggered, capacitor connects reverse voltage across SCR_1 and it turns OFF

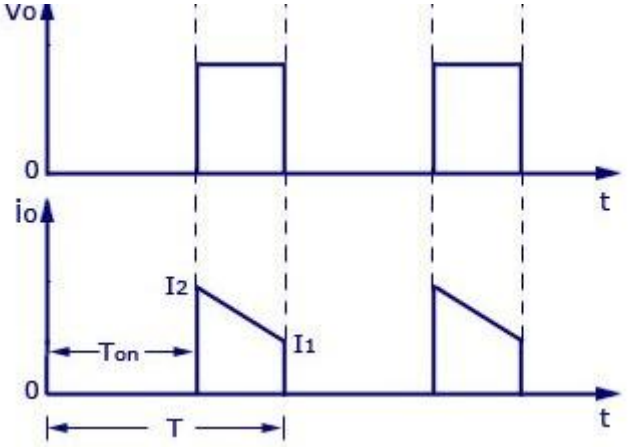
(f) Draw circuit diagram of step-up chopper. Explain its working with i/p & o/p waveforms.

Ans: (Circuit Diagram 2 M, Waveforms 1M, working explanation 1 M.)

Circuit diagram of step-up chopper



Waveforms:



Working: When chopper switch is ON, the inductor L is connected to the supply E_{dc}, and inductor stores energy during ON-period t_{on}. When the chopper switch is OFF, the inductor current is forward to flow through the diode and load for a period t_{off}. As the current tends to decrease, polarity of the emf induced in the inductor L is reversed to that shown in Fig. 5 and as a result voltage across the load E_o becomes $E_{dc} + L\frac{di}{dt}$ i.e. the inductor voltage adds to the source voltage to force the inductor current into the load. In this manner, the energy stored in the inductor is used to the load.

$$E_0 = \frac{E_{dc}}{(1 - D)}$$

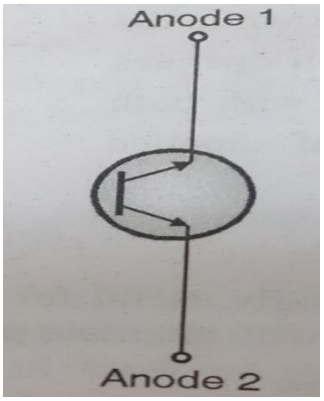
where, $D = \text{Duty cycle} = \frac{t_{on}}{t_{on} + t_{off}}$

3. Answer any four **16 marks**

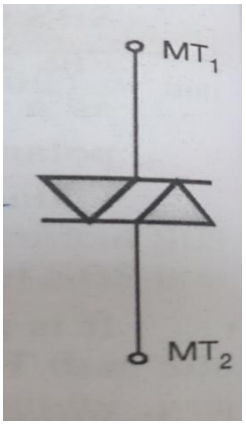
a) Draw symbol and characteristics of DIAC, SUS.

Ans:- **(symbol and characteristics of DIAC and SUS- 1 mks each)**

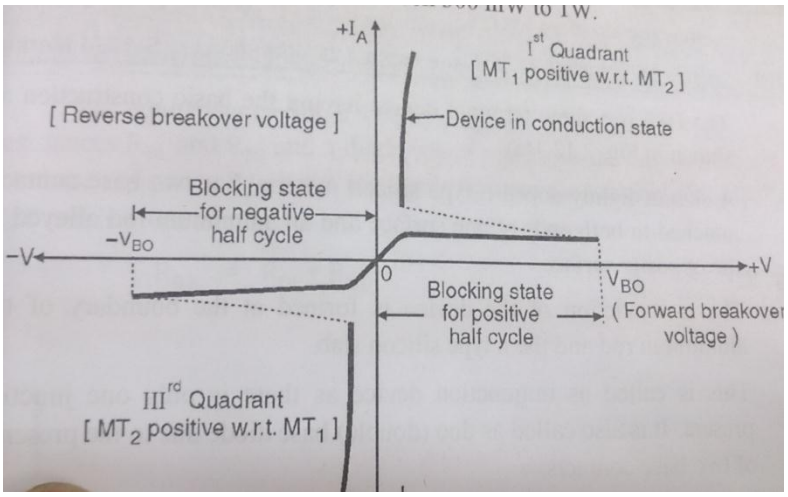
Symbol of DIAC



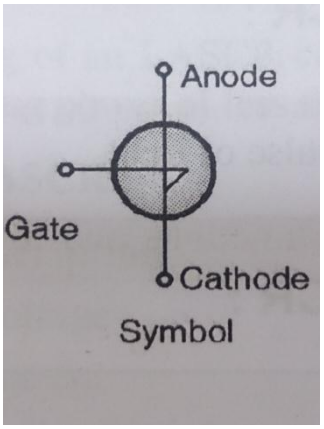
OR

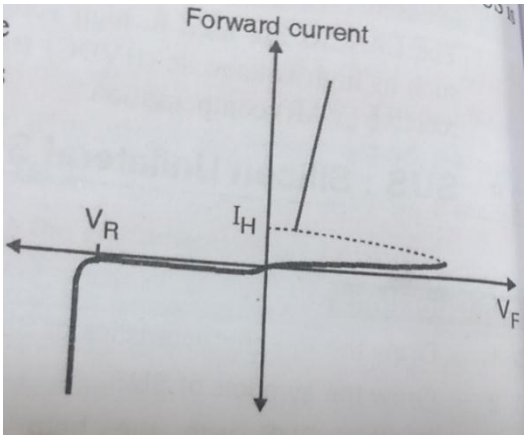


Characteristics of DIAC



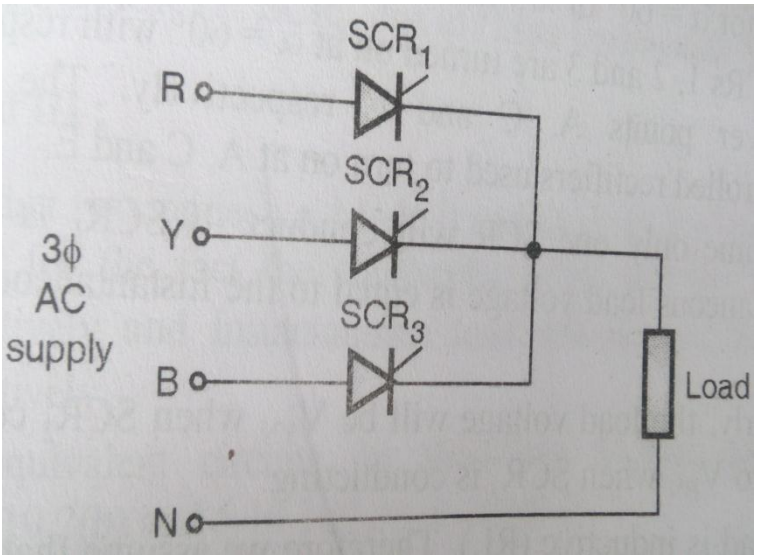
Symbol and Characteristics of SUS

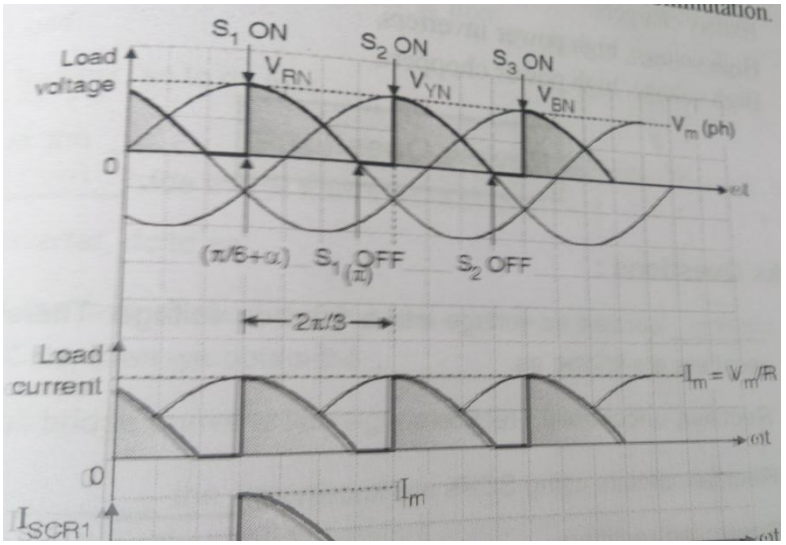




b) Draw circuit diagram of three phase half wave controlled rectifier circuit with o/p voltage waveform.

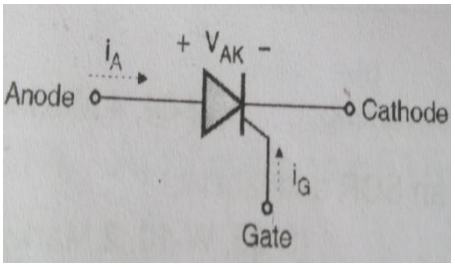
Ans**:-(Circuit diagram of three phase half wave controlled rectifier- 2 mks, Waveforms – 2 mks)**

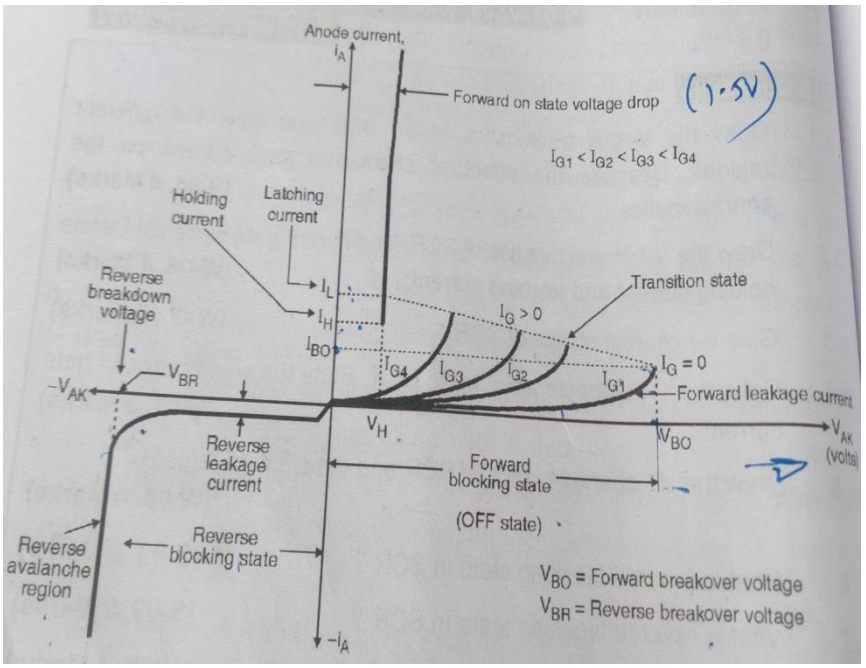




c) Draw symbol of SCR. Draw its static V I characteristics. Name various regions on it.

Ans**:-(Symbol- 1 mks, V I characterictics—2 mks, regions – 1mks)**





Various regions are-

1 .Forward blocking region

2. Forward conducting region

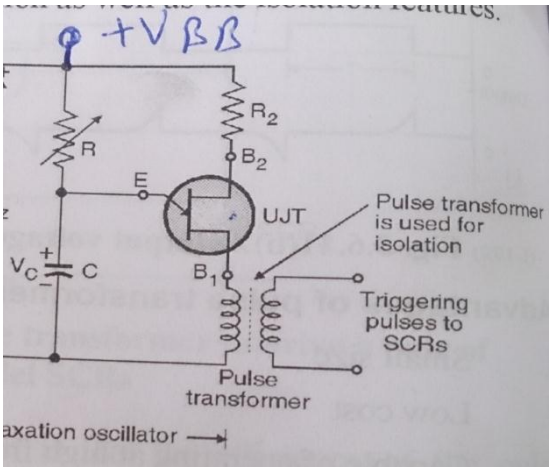
3. Transition state

4. Reverse blocking region

5. Reverse conducting region

d) Using UJT relaxation oscillator circuit show how SCR can be fired? Draw circuit and O/P pulses ,capacitor voltage waveform.

Ans:- **(UJT relaxation oscillator circuit- 2 mks, Explanation- 1mks, O/P pulses, capacitor voltage waveform- 1 mks)**



Explanation: As soon as the biasing voltage V_{BB} is applied to the circuit, capacitor starts charging towards V_{BB} voltage through resistance R. As soon as capacitor voltage reaches upto

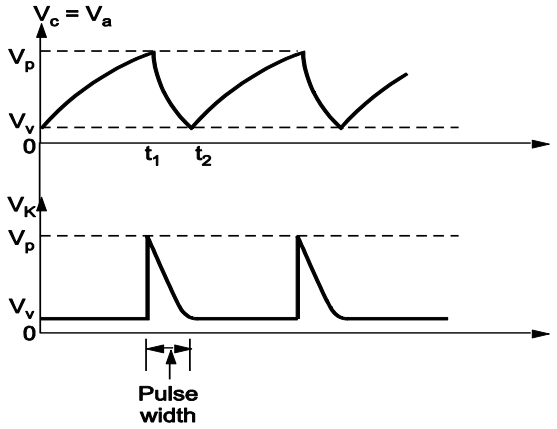
V_p voltage, the PUT turns ON and the capacitor discharges. The V_p voltage is set by the voltage divider consisting of two resistors R_{B1} and R_{B2},

$$V_p = V_g + 0.6$$

where, $$V_g = \frac{R_{B1}}{(R_{B1} + R_{B2})}$$

As capacitor charges upto V_p, PUT turns ON and hence capacitor discharges through PUT and R_3 and it produces positive triggering pulses.

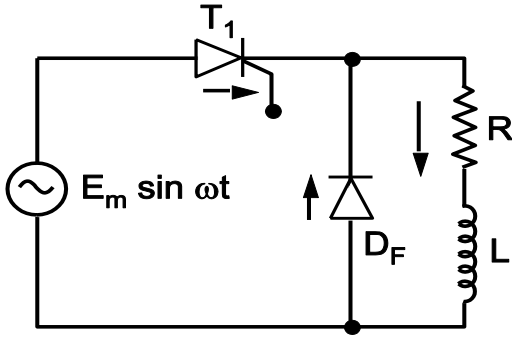
The capacitor and o/p pulse waveforms are as shown-



e) Draw half wave controlled rectifier (RL) load with freewheeling diode. Explain the effect of freewheeling diode on the circuit with o'/p waveform.

Ans:- **(Diagram – 2 mks, effect of freewheeling diode in waveforms with explanation 2 mks)**

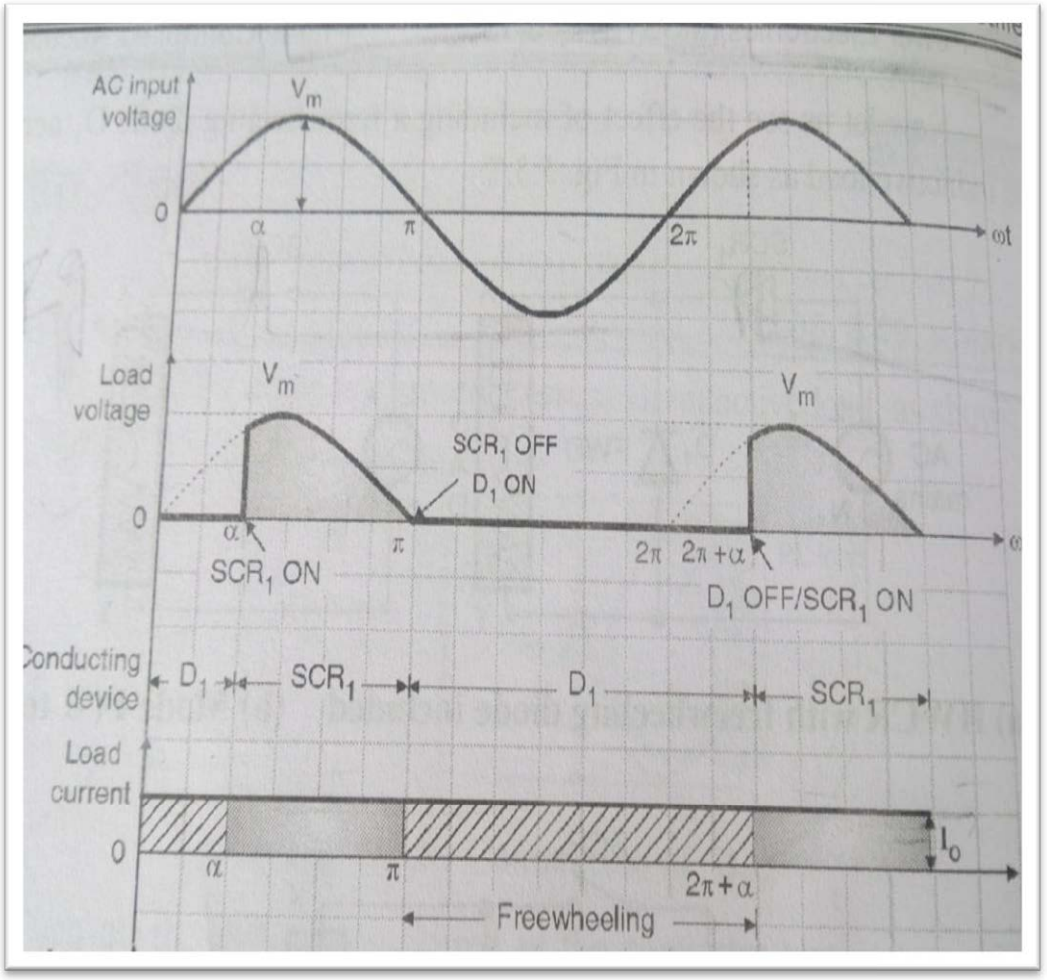
Diagram-



Effects of freewheeling diode :

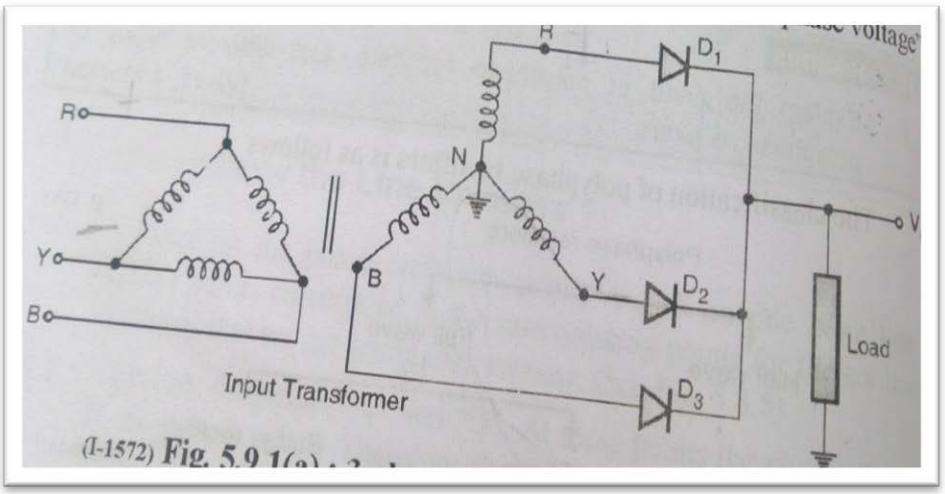
(i) Due to freewheeling diode the load voltage does not become negative and hence average d.c. output voltage not reduces.
(ii) Load current becomes continuous i.e. ripple free.
(iii) It prevents reversal of load voltage.
(iv) Input power factor is improved.

Waveforms-

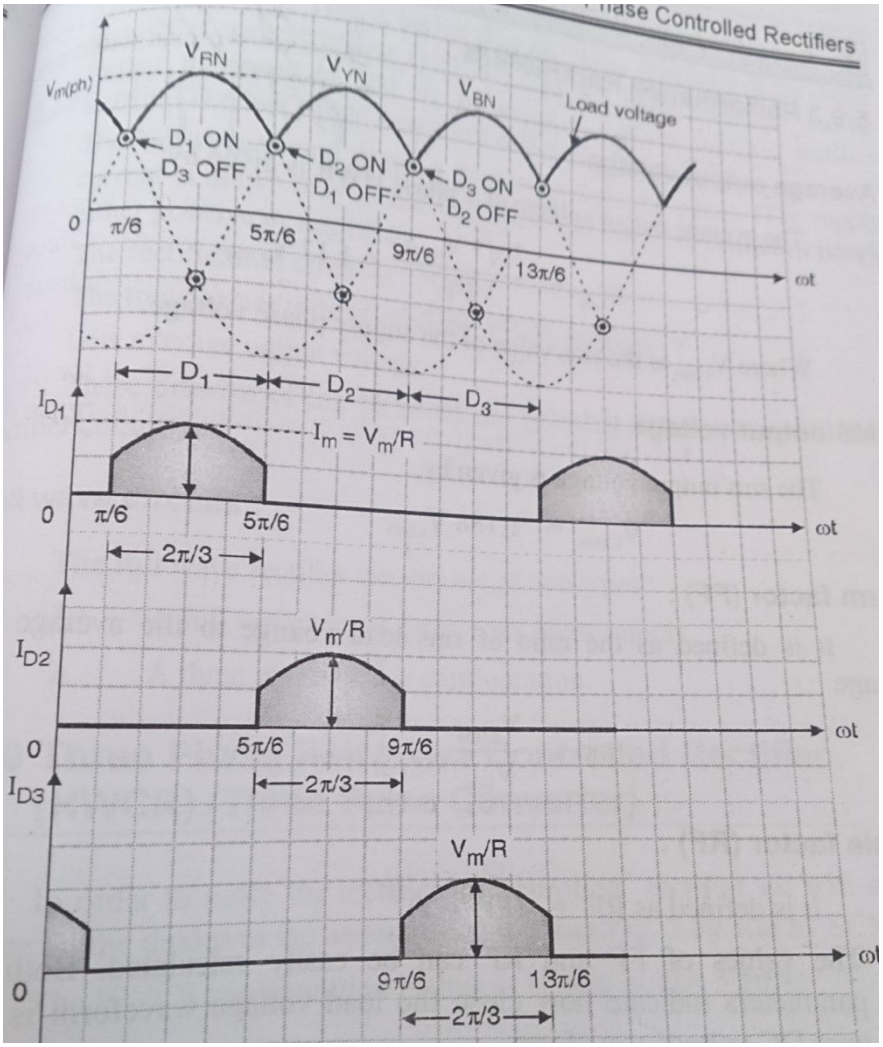


f) Sketch circuit of three phase uncontrolled half wave rectifier (Resistive load). Draw its i/p and o/p waveforms.

Ans:- (Diagram – 2mks, waveforms- 2 mks)



(I-1572) Fig. 5.9.1(a)



4. Answer any four **16 marks**

a) What is the need of inverter? List four applications of inverters.

Ans:- (Need – 2 mks, 4 applications- 2 mks)

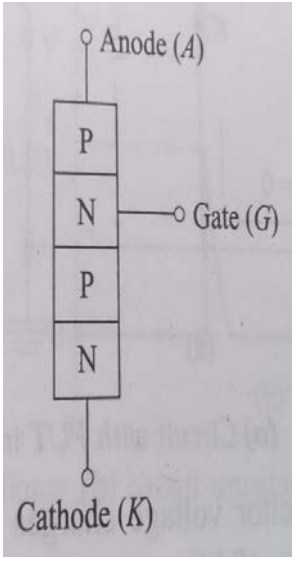
Inverter : Inverter is a circuit which converts d.c. power into a.c. power at desired output voltage and frequency which are required in UPS, low power portable electronics systems, AC motor speed control etc.

Applications of inverters :

1.Variable speed a.c. motor drives.
2.Induction heating.
3.Aircraft power supplies.
4.Uninterrupted power supplies (UPS).
5.High voltage d.c. transmission lines.
6.Battery vehicle drives.

b) Explain constructional details of PUT. Why it is called programmable?

Ans:- (Construction- 1 mks, explanation- 1 mks ,Why called programmable – 2mks)



Details-As shown a PUT consists of four layer (PNPN) , three terminal device anode ,cathode and gate(nearer to anode- called as anode gate) operates similar to UJT. The gate PN junction controls the ON and OFF states of PUT.

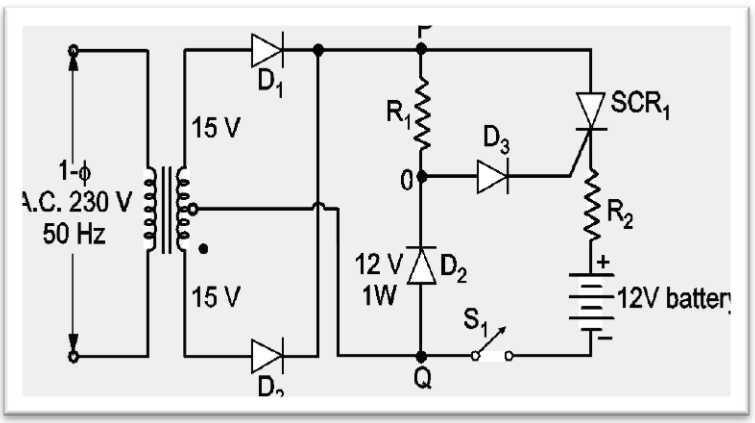
PUT is called programmable- The PUT is called as programmable because its intrinsic standoff ratio ή and triggering voltage Vp can be changed by external voltage divider resistors R2 and R3 as given below

ή = R3. VBB/(R2+R3)

VP= ή VBB+VD

c) With the help of appropriate circuit diagram explain working of battery charging regulator.

Ans:-(Diagram 2 mks, Explanation – 2 mks)



Explanation :

1. A 12 V discharged battery is connected in the circuit. When switch S_1 is closed, the single-phase 230 V supply is stepped down to (15-0-15) V by a centre-tapped transformer. Diodes D_1 and D_2 form full-wave rectifier. Due to this, the pulsating d.c. supply appears across the terminals P and Q.
2. When SCR_1 is OFF, its cathode is held at the potential of discharged battery. During each positive half-cycle when the potential of point O rises to sufficient level so as to provide to SCR_1 and it is turned ON.
3. When SCR_1 is turned ON, the charging current flows through the battery. Thus, during each positive half-cycle of pulsating d.c. supply, voltage across P-Q, SCR_1 is triggered and charging current is passed till the end of that half-cycle. Due to the zener diode D_z, the maximum voltage of point O is held at 12 V. Due to the charging process, the battery voltage rises and finally attains full value of 12 V. Thus, when the battery is fully charged, the cathode of SCR_1 is held at 12 V. Therefore diode D_3 and gate-cathode junction of SCR_1 cannot be forward biased, since the potential of point O can reach upto 12 V. Hence, no gate-current is supplied and SCR_1 is not triggered. In this way, after charging further charging is automatically stopped.

d) Compare linear regulator with SMPS on the basis of-
1) Efficiency
2) Power dissipation
3) Ripple
4)Heat sink

Ans:-(Relevant points- 4 mks)

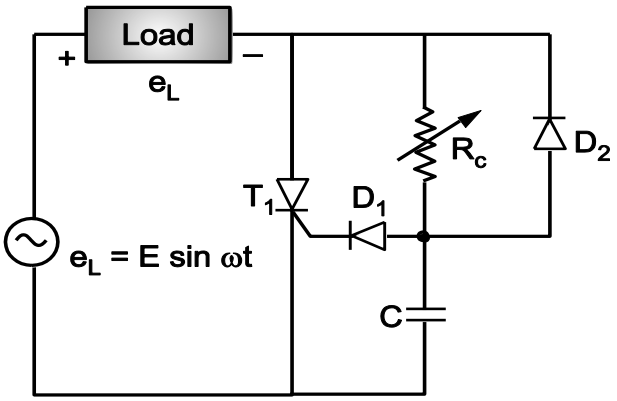
Parameters	**linear regular**	**SMPS**
Efficiency	**low**	**high**
Power dissipation	**more**	**low**
Ripple	**low**	**high**
Heat sink	**Large size of heat sink**	**Small size of heat sink**

e) It is required to fire SCR from 0 to π in sinusoidal i/p. Suggest a firing circuit. Explain it with neat circuit diagram.

Ans:- (Name of Firing circuit- 1 mks, diagram 2 mks, explanation 1 mks)

The RC-triggering circuit provides the firing angle 0 to π.

The circuit is as shown-

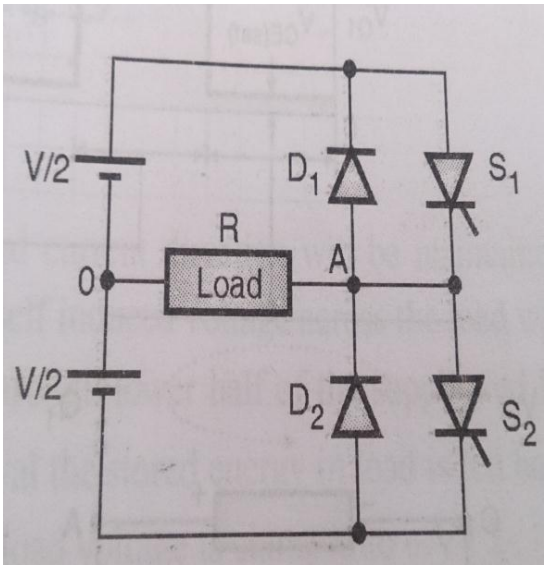


Explanation- In this circuit the initial voltage from which capacitor C charges is almost zero. Capacitor C is set to the low positive voltage by the clamping action of SCR. When the capacitor charges to a voltage equal to Vg min , SCR triggers and rectified voltage eL appears across load as VL. The value of R_C is obtained from the following relation-

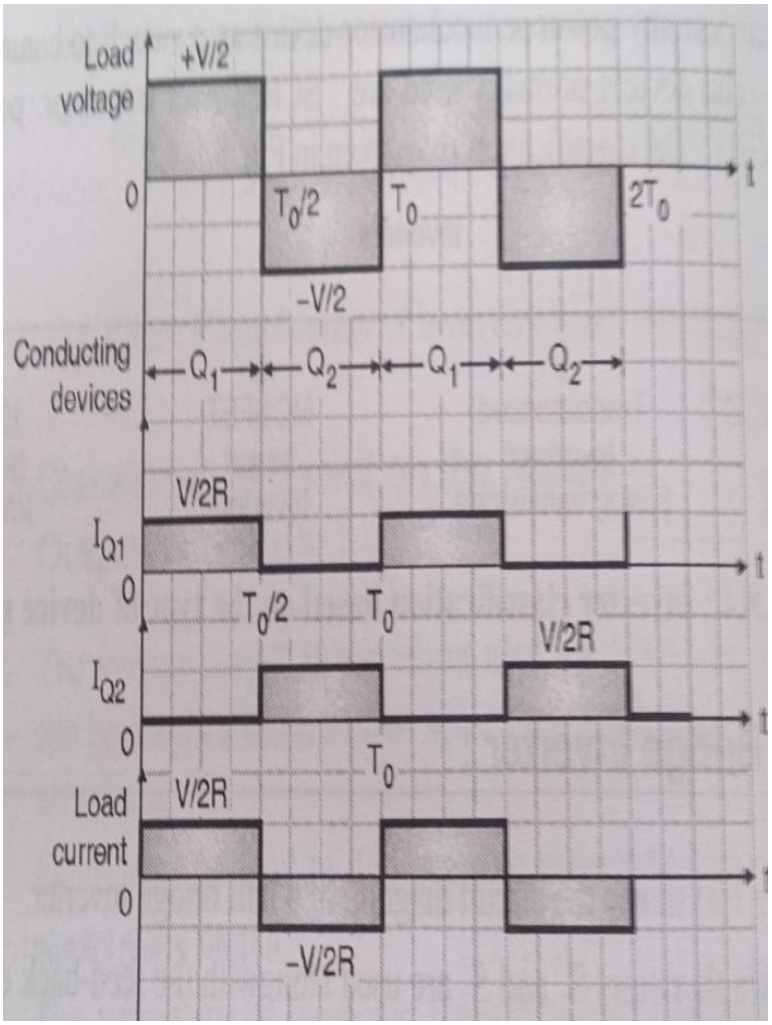
$$R_C \leq (Vs\text{-}Vgmin) / Igmin$$

f) Draw circuit diagram of single phase half bridge inverter. Explain its working with o/p voltage waveform.

Ans:- (Diagram 2 mks, explanation 1 mks, waveforms – 1 mks)



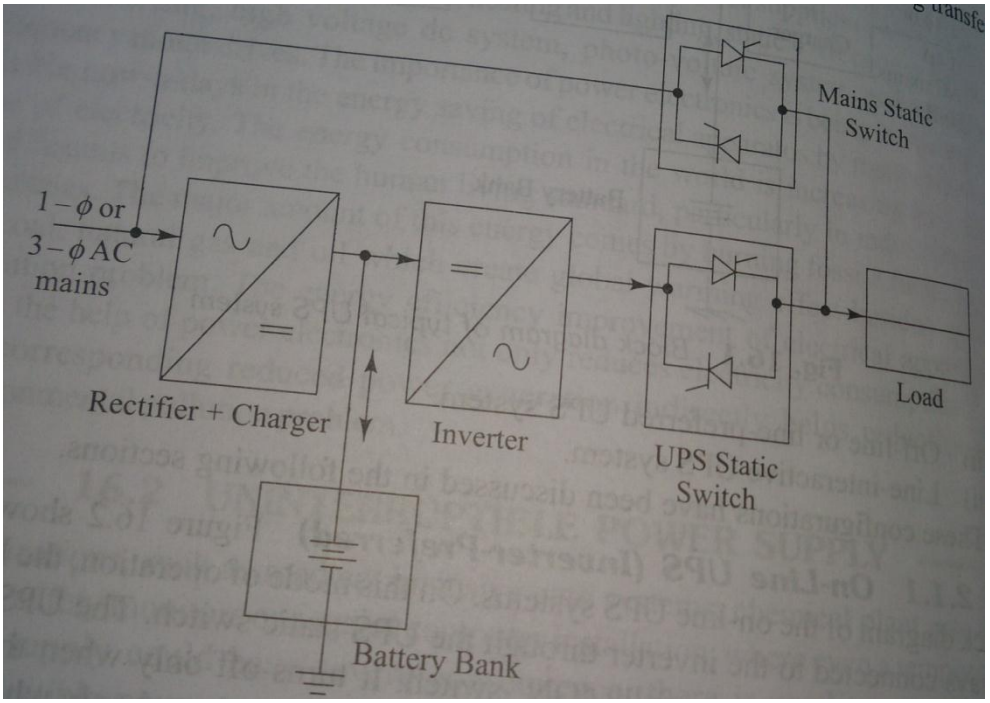
Explanation-The thyristor S1 is turned on for a time To/2 , which makes the instantaneous voltage across the load Vo= V/2.
If thyristor is turned on at instant T0/2 by turning S1 off then –V/2 appears across the load. Thus a square wave is produced across the load.
A precaution must be taken while designing the control circuit so that both the thyristors are on simultaneously as it will short circuit the source and may damage the thyristors.



5. Answer any four **16 marks**

a) With the help of block diagram explain principle of ON LINE UPS.

Ans:- **(Block diagram-2 mks, explain -2 mks)**



Explanation:- Block diagram of the on line UPS systems is as shown where the load is connected to the invertor through the UPS static switch. The UPS static switch is normally ON switch. It turns off only when the UPS system fails. In that case the mains static off switch is used only when UPS is to be bypassed.The various operating modes are

Mode 1:-When the AC mains is on, the inverter circuit will supply the power to the inverter as well as to the battery. Therefore it acts as a rectifier cum charger .Hence its ratings are usually higher. The inverter o/p is connected to the load via UPS static switch. Battery will be charged in this mode.

Mode 2:-If the supply fails suddenly, the rectifier o/p will be zero and hence the battery bank now supplies power to the inverter without any interruption and delay. There will not be any inverter as well as the load.

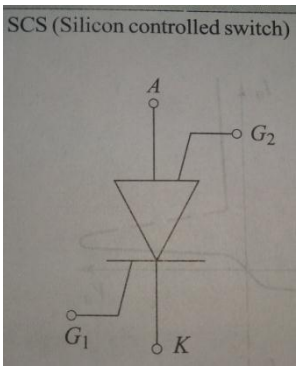
After restoration of the line supply,the charger supplies the inverter and recharges the battery automatically first in constant current mode and then in constant potential mode.

Mode3 :-In case if the inverter /UPS fails, then the normally OFF mains static switch is turned on which automatically transfers the ac line to the load in less than ¼ th of the cycle period with no phase discontinuity.

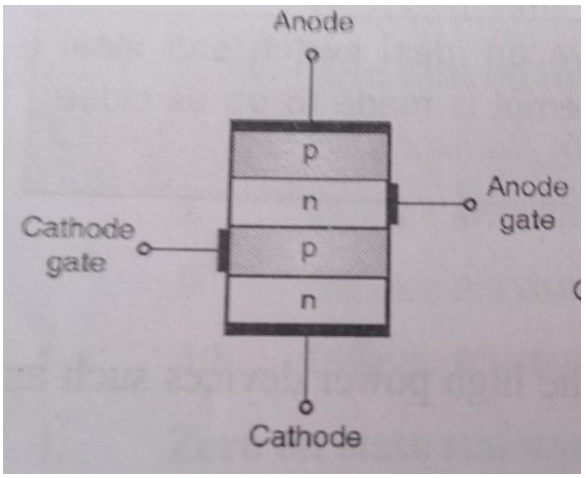
b) Draw symbol of SCS. Draw its constructional details. How SCS is turned ON and turned OFF.

Ans**:-(Symbol -1 mks, constructional details-1 mks , SCS turned ON and turned OFF- any 2 methods for each, so 1 mks each).**

Symbol



Constructional details



Turn ON of SCS-a)positive pulse at G_K

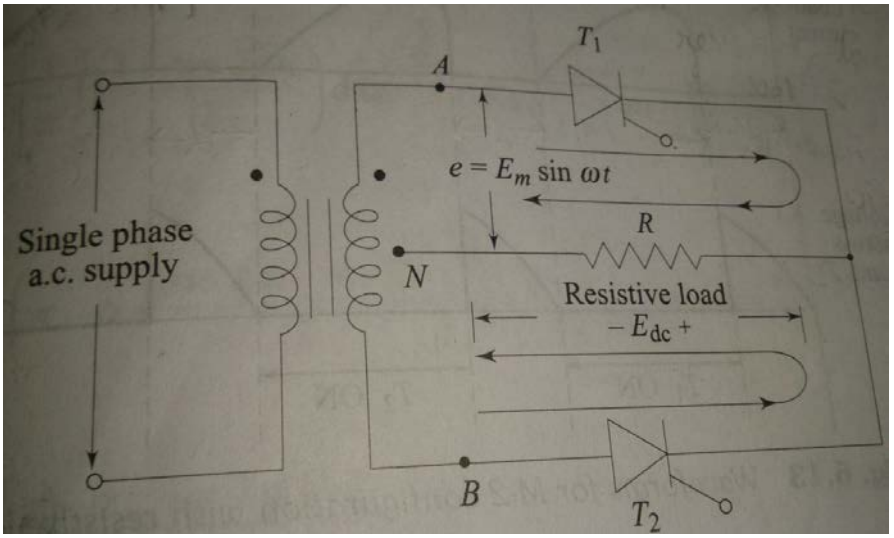
b)negative pulse at G_A

Turn OFF of SCS- Three methods

a) By reducing anode current below I_H
b) by applying a negative pulse at G_K
c) By applying a positive pulse at G_A

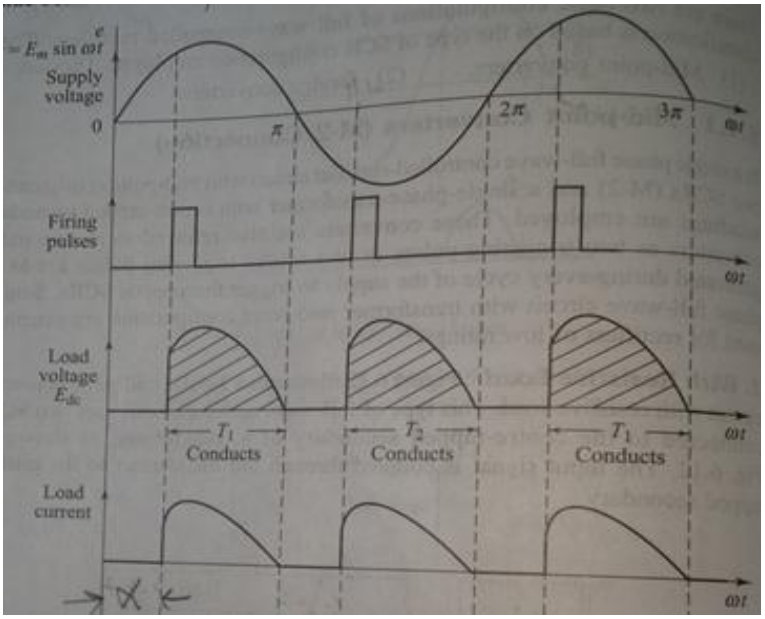
c) Explain working of centre tapped full controlled rectifier (R load) with neat circuit diagram and i/p o/p voltage and current waveforms.

Ans:- **(Diagram 1 mks, explanation 1 mks, waveforms 2 mks)**



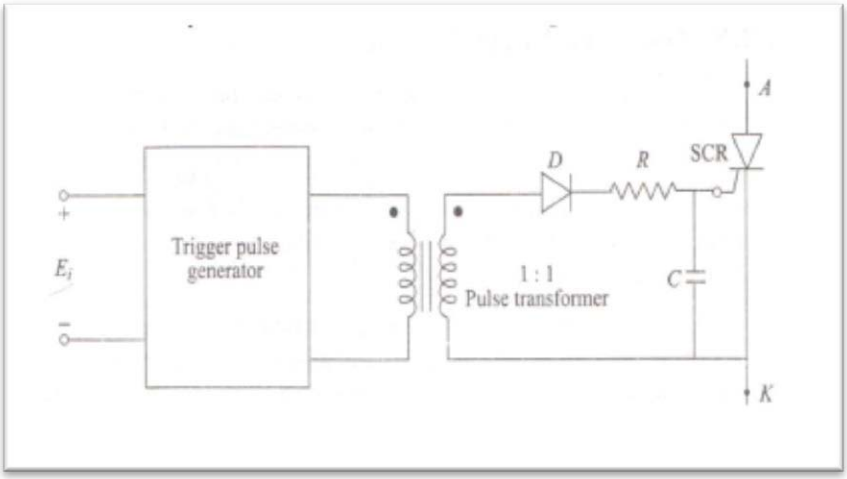
Explanation:-During positive half cycle of AC supply, A is positive with respect to B ,this makes T1 forward biased and T2 is reverse biased. But since no triggering pulse is applied ,both are in off state. When SCR T1 is triggered at firing angle α, current flows through load from A ,T1 and back to centre tap of the transformer. This current flow is continuous till angle π when the line voltage reverses the polarity and T1 is turned off.

During negative half cycle of AC supply, B is positive with respect to A ,this makes T2 forward biased and T1 is reverse biased. But since no triggering pulse is applied ,both are in off state. When SCR T2 is triggered at firing angle α+π, current flows through load from B ,T2 and back to centre tap of the transformer. This current flow is continuous till angle 2π ,when the line voltage reverses the polarity and T2 is turned off. The operation is as shown in waveeforms.



d) With neat circuit diagram , explain how pulse transformer is used for firing SCR.

Ans:- **(Diagram 2 mks, explanation 2 mks)**



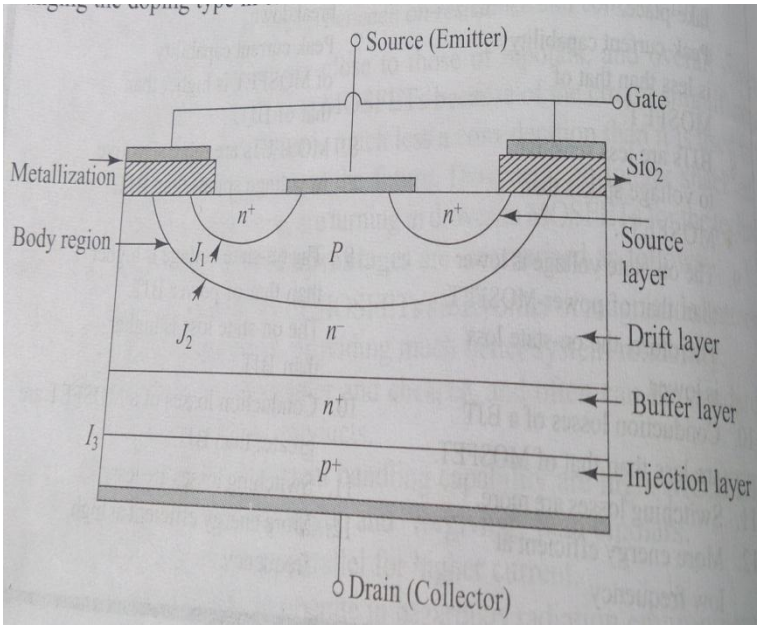
Pulse transformers are often used to couple a trigger pulse generator to a thyristor in order to obtain electrical isolation between the two circuits. The transformers commonly used for thyristor control are either 1:1 two winding or 1:1:1 three winding types. Figure shows a complete output circuit to fire a thyristor correctly.

The series resistor R either reduces the SCR holding current or balances gate current in a three winding transformer connected to two SCRs. The series diode D prevents reverse gate current in the case of ringing or reversal of the pulse transformer output voltage. The diodes also reduce holding current of the SCR.

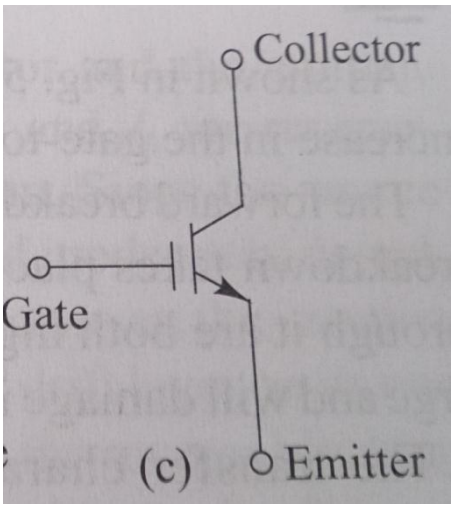
In some cases where high noise levels are present it may be necessary to load the secondary of the transformer with a resistor to prevent false triggering.

e) Draw constructional diagram of n channel IGBT. Draw its symbol .List its applications.

Ans:- **(Constructional diagram -2 mks, symbol-1 mks,2 applications-1 mks)**



Symbol-



Applications:-
1) AC and DC motor drives
2) High frequency SMPS
3) Inverters
4)Choppers

f) Compare three phase uncontrolled and controlled rectifier (Resistive load) (any four points).

Ans**:-** **(Relevant 4 points- 4 mks)**

Parameters	Controlled rectifiers	Uncontrolled rectifiers
Devices used	SCR and diodes	Only diodes
Control of load voltage	Load voltage can be controlled	Load voltage cannot be controlled
Direction of power flow	Source to load and sometimes load to source	Not necessary
Triggering circuit	Required	Not required
Application	DC motor controller, battery chargers	Power Supply

6. Answer any four **16 marks**

a) Write function of:
1) Switching element
2) Catch diode
3) LC Filter
4) Comparator in SMPS

Ans**:-(Each function 1 mks)**

1) **Switching element-**It operates at the high frequencies of 20KHz to 1 MHz , chopping the DC voltage into a high frequency square wave.

2) **Catch diode-** The "catch" diode on the primary side of a transformer-coupled SMPS serves the same purpose it does on any other inductive load such as a relay.When the power supply is switched off , the voltage on the i/p side of the inductor tries to fly below ground but it is clamped when the catch is forward biased. The stored energy then continuous flowing to the o/p through the catch diode and the inductor. or clamp diode

3) **LC Filter-** It converts the pulsating DC into pure DC removing the ripples.

4) **Comparator –** It compares a portion of the o/p with the fixed reference voltage and the error signal is used to control the on-off times of the switch thus regulating the o/p.

b) A single phase half wave rectifier is used to supply power to load impedance 10 Ω from 230 V 50 Hz supply at firing angle 30^0. Calculate average load voltage.

Ans**:-(Formula 2 mks, proper answer 2 mks)**

Given parameters

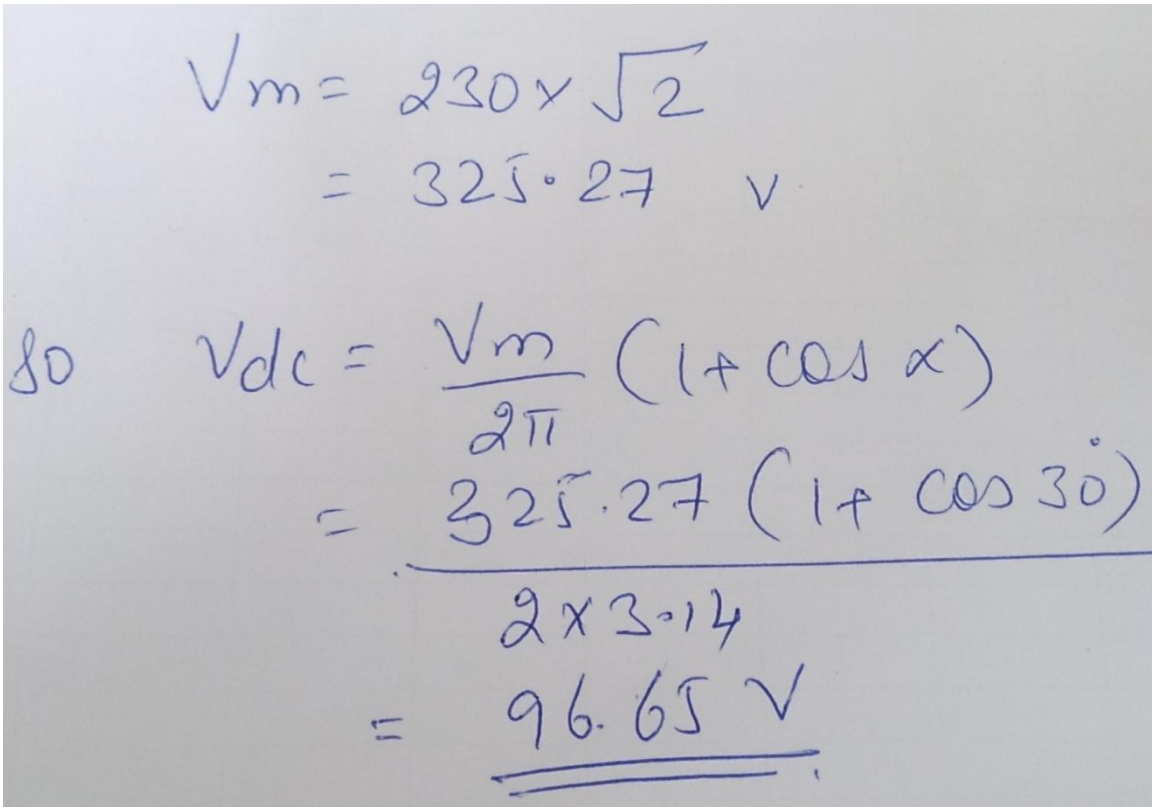
Load impedance= 10 Ω

Supply =230 V, 50 Hz

Firing angle=α= 30 º.

Average load voltage= ?

Average load voltage= (Vm /2π) (1 +cosα)



c) Compare natural and forced commutation w r t need of external commutating components, types of supply, cost of commutation circuit, power dissipation.
Ans:- **(Proper points 4 mks)**

Parameters	Natural Commutation	Forced Commutation
Need of external commutating components	Not required	Required
Types of supply	Source is AC	Source is DC
Cost of commutation circuit	Not required so less cost.	Commutation circuits are costly
Power dissipation.	Less as no power loss takes place in the components	More – as some power loss takes place in the components

d) Define following parameters for GTO
1) Maximum gate to cathode reverse voltage
2) Maximum controllable anode current
Ans:-

Maximum gate to cathode reverse voltage (2mks)

It is the maximum repetitive reverse voltage the GTO is able to withstand. For all asymmetric GTOs this value is in the range of 20-30 V, since it is determined by the gate cathode junction break down voltage. Due to the anode shorted structure of the GTO the anode – base junction

(J1) does not block any reverse voltage. Unlike VDRM, VRRM rating may be exceeded for a short time without destroying the device. This "reverse avalanche" capability of the GTO is useful in certain situations

Maximum controllable anode current **(2mks)**

In GTO, there is always a maximum value of controllable anode current. If the anode current exceeds this value, then no gate current can turn off the conducting GTO. If an attempt is made to turn off a GTO, an anode current which is greater than maximum controllable value, then it will be damaged.

e) List four applications of power MOSFET. Why thermal run away does not take place in power MOSFET?

Ans:-Four applications of power MOSFET- **(any 4 points-2 mks)**

1) high frequency inverters
2) in SMPS
3) in UPS
4) solenoid or relay driver

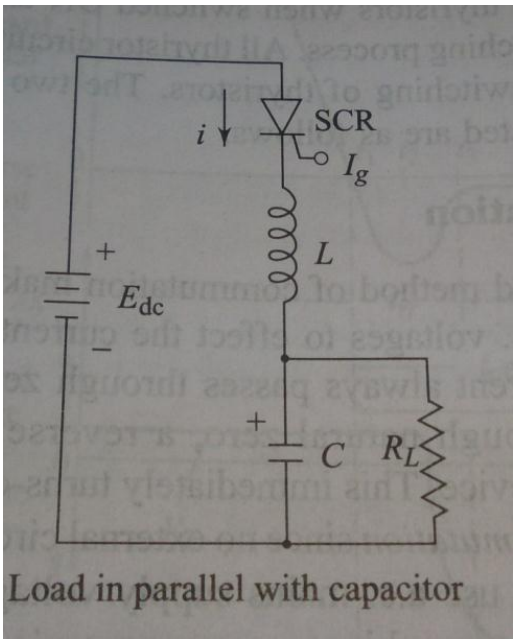
Thermal run away does not take place in power MOSFET- **(2mks)**

This is because the RDS has a positive temperature coefficient and hence the leakage current is relatively low in the order of few nanoamperes.

f) Draw the circuit of class A commutation for SCR and describe its operation.

Ans:- **(Diagram 2 mks, explanation with waveforms -2 mks)**
(Note- Either load in parallel or series to be explained- anyone should be considered.)

Class A commutation with load in parallel is as shown below-



Load in parallel with capacitor

Operation of the circuit

At t=to the SCR is turned on, the dc supply voltage is applied to the resonant circuit. Due to presence of under damped LC resonant circuit, the anode current of SCR is sinusoidal in nature. At t =t1, the voltage on capacitor C reaches Its maximum & the anode current goes to Zero. The capacitor will then attempt to Force a reverse current through SCR1 and SCR will be turn off. As soon as SCR is turned off, the capacitor starts discharging through R. the voltage Across SCR1 at the instant t1 is negative as The Voltage on capacitor C is higher than the Input supply voltage Vs.