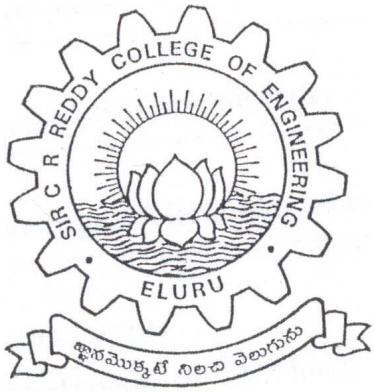
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

MANUAL
FOR
POWER ELECTRONICS LABORATORY



Department Of Electrical & Electronics Engineering
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INDEX

EXPT. NO. – 1. CHARACTERISTICS OF DIAC AND SCR

Aim : - **1. To plot the V-I characteristics of a Diac.**
2. To plot the V-I characteristics of Silicon controlled rectifier.

Apparatus: -

Sl.No.	APPARATUS	RANGE	QTY.
1.	Diac	DB3	1
2.	SCR	TYN604	1
3.	Resistor	1kΩ, 5W and 1kΩ, 10W	1
4.	Milliammeter	(0-200mA) MC	each
5.	Voltmeter	(0-30V)MC and	1
		(0-100V)MC	1
6.	Dual DC power supply	0-30V, 2A	each
7.	DC Power supply	0-30V, 2A	1
8.	Connecting Board	--	1
9.	Connecting Wires	--	1
			--

Procedure : - a) For Characteristics of Diac

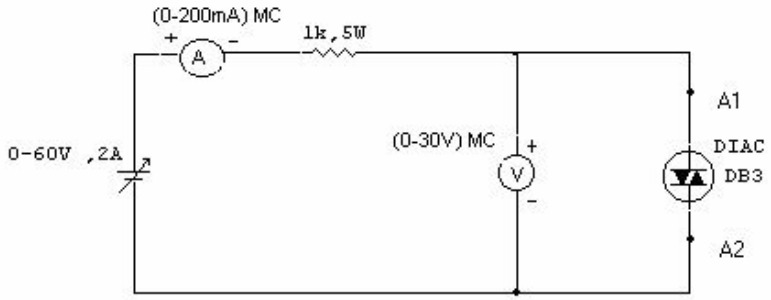
1. The connections are made as shown in the circuit diagram.
2. With the voltage varying knobs of the power supply at minimum positions the power supply is switched ON.
3. The voltage is varied in steps and the corresponding values of currents are noted.
4. The voltage is varied in steps until the pointer of the voltmeter kicksback and the values of voltage and current are noted at that point.
5. The current is decreased in steps until the milliammeter kicksback and the reading of the milliammeter at that point gives the holding current of the diac.
6. The voltage varying knobs are brought back to their minimum positions and the power supply is switched OFF.
7. The characteristic of V vs I is plotted in the first quadrant.
8. The DC power supply connections are interchanged and step Nos. 2 to 6 are repeated to plot the characteristics in the third quadrant.

b) <u>For Characteristics of SCR</u>

01. The connections are made as shown in the circuit diagram.
02. With the voltage varying knobs of the power supply at minimum positions, the Power supply is switched ON.
03. The gate current I_g is adjusted to some convenient value and the voltage V_{AK} is Varied in steps.
04. The values of V_{AK} and I_A are noted for each step until the voltmeter kicks back.
05. The value of V_{AK} at the instant of kicking back of voltmeter is noted.
06. The gate circuit of the silicon-controlled rectifier is opened, the value of I_A is Decreased in steps and the corresponding values of V_{AK} are noted.
07. The value of I_A at which the milliammeter kicks back is noted which gives the Holding current I_H of the silicon-controlled rectifier.

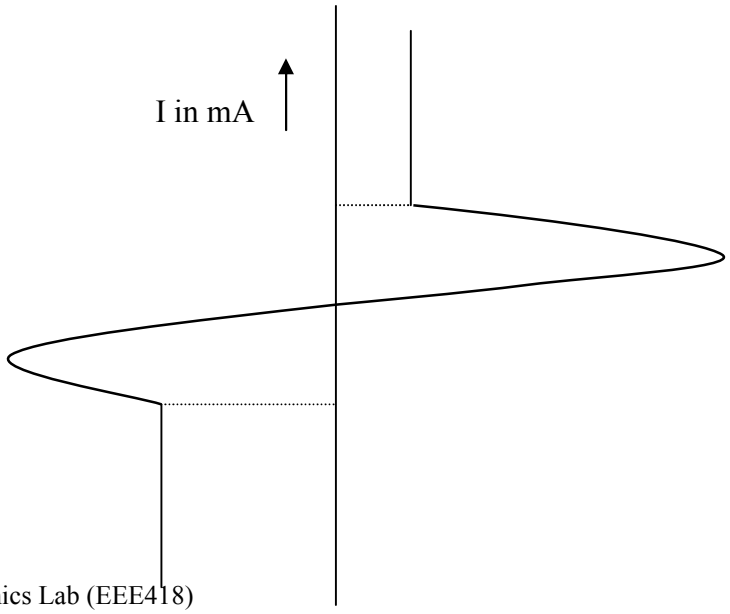
08. The voltage varying knobs are brought back to their minimum positions and the Power supply is switched OFF.
08. Step Nos. 2, 3, 4, 5, 6 and 7 are repeated for different gate currents.
09. The characteristic of V_{AK} vs. I_A is plotted.
10. The points $V_{BO1,}$ $V_{BO2,}$ I_{H1} and I_{H2} are marked on the curve.

Circuit diagram : - **a) For Characteristics of Diac**



Tabular column : -

Sl.No.	For A_1 Positive		For A_2 Positive	
	V in volts	I in mA	V in volts	I in mA



Nature

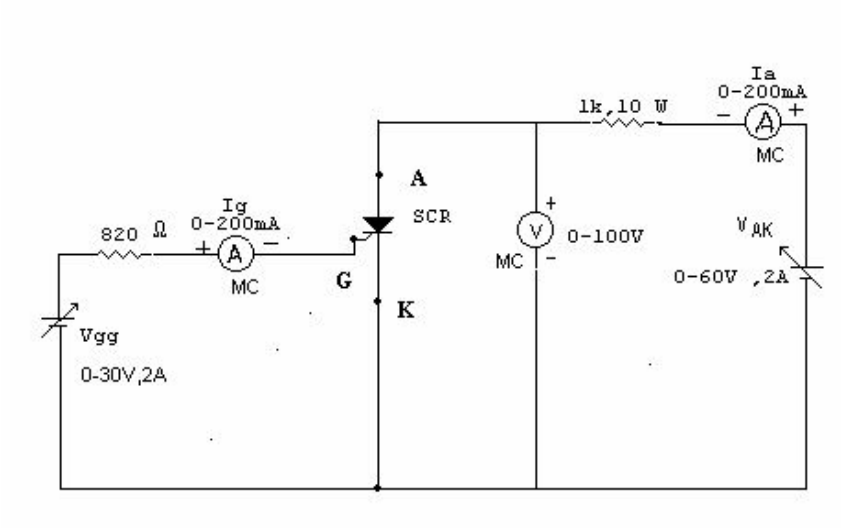
of graph : -

Circuit diagram : - **b) For Characteristics of SCR**

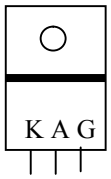
V in volts ←

→ V in volts

↓ I in mA



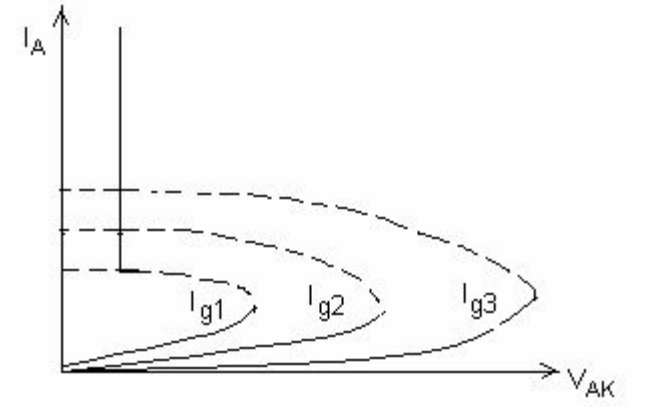
Lead Identification :- For TYN 604



Tabular Column: -

Sl.No.	I_{g1} =		I_{g2} =		I_{g3} =	
	V_{AK} in volts	I_A in mA	V_{AK} in volts	I_A in mA	V_{AK} in volts	I_A in mA

Nature of Graph :-



Viva - Voce Questions:

1. What is the relation between breakdown voltage of SCR and Gate current?
2. Why the number of SCRs connected in parallel provide total rated current less than the sum of individual ratings?
3. What are the turn – off times of converter grade and inverter grade SCRs?
4. On what factors turn off time of SCRs depends?
5. What is the difference between holding current and latching current?
6. Among Holding and Latching Currents which one will be higher?
7. What is the effect of negative gate current on SCR?
8. What is the core used in pulse transformer?
9. What type of gate signal is most suitable for SCR ?
10. What is the purpose of transformer in triggering circuit of SCR?
11. State one difference between Thyristors and Triac?

EXPT. NO. – 2 CHARACTERISTICS OF TRIAC

Aim : - **To plot the V-I characteristics of a Triac.**

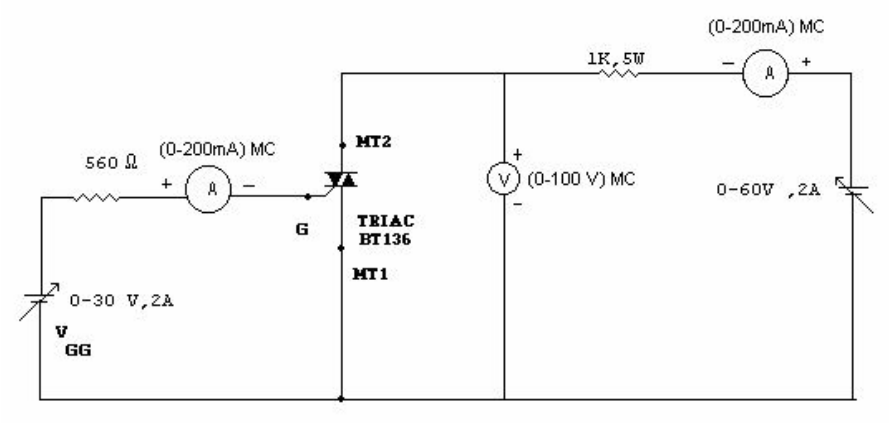
Apparatus : -

Sl.No.	APPARATUS	RANGE	QTY.
1.	Triac	BT 136	1
2.	Resistor	560 Ω and 1KΩ,5 W	1 each
3.	Milliammeter	(0-200mA) MC	1
4.	Voltmeter	(0-100V) MC	1
5.	Dual DC power supply	0-30V, 2A	1
6.	DC power supply	0-30V, 2A	1
7.	Connecting Board	--	1
8.	Connecting Wires	--	--

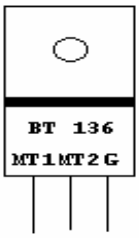
Procedure : -

2. The connections are made as shown in the circuit diagram.
3. With the voltage varying knobs of the power supply at minimum positions the power supply is switched ON.
4. The gate current I_g is adjusted to some convenient value and the voltage V_t across the triac is varied in steps and the corresponding values of V_t and I are noted.
5. The value of V_t is varied in steps until the pointer of the voltmeter kicksback and the corresponding values of V_t and I are noted.
6. The current I is decreased in steps until the milliammeter kicksback and the reading of the milliammeter at that point gives the holding current of the triac.
7. The voltage varying knobs are brought back to their minimum positions and the power supply is switched OFF.
7. The characteristic of V vs. I is plotted in the first quadrant.
8. The DC power supply connections are interchanged and step Nos. 2 to 6 are repeated.
9. The characteristics of V vs. I are plotted in the third quadrant.

Circuit Diagram :-



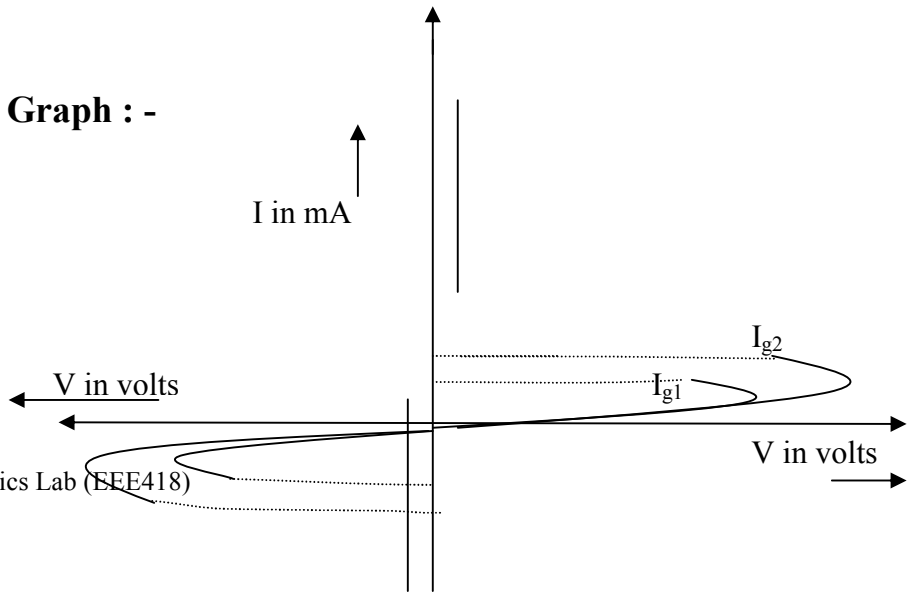
Lead Identification :- For BT136

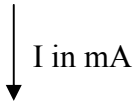


Tabular Column :-

Sl.No.	First Quadrant				Third Quadrant			
	I_{g1}=		I_{g2}=		$I_{g1=}$		$I_{g2=}$	
	V_t in volts	I_A in mA	V_t in volts	I_A in mA	V_t in volts	I_A in mA	V_t in volts	I_A in mA

Nature Of Graph : -





Viva-Voce questions:

1. What is the symbol of TRIAC?

2, How many modes of operation of Triac are possible?

3. When MT_2 is positive with respect to MT_1, what polarity gate current should be applied for greater gate sensitivity?

4. When MT_2 is negative with respect to MT_1, what polarity gate current should be applied for greater gate sensitivity?

5. What are the applications of Triac?

6. What are the disadvantages of Triac when compared with SCR regarding Turn-off time?

7. What are the maximum ratings of Triac available?

8. Give one advantage of Triac?

9. Give one disadvantage of Triac?

10. How many heatsinks are required for a Traic?

EXPT. NO. – 3. *CHARACTERISTICS OF UNIJUNCTION TRANSISTOR AND UJT AS A RELAXATION OSCILLATOR*

Aim :- 1. To plot the V-I characteristics of a Unijunction transistor.
2. To study the operation of Unijunction transistor as a relaxation oscillator.

Apparatus :-

Sl.No.	APPARATUS	RANGE	QTY
01.	Unijunction Transistor	2N2646	1
02.	Resistors	50 Ω,220 Ω,270 Ω and1KΩ	1each
03.	Milliammeter	(0-200 mA) MC	1
04.	Voltmeter	(0-30 V) MC	1
05.	Dual Dc Power Supply	0-30 V, 2 A	1
06.	Decade Resistance Box	--	1
07.	Decade Capacitance Box	--	1
08.	Cathode Ray Oscilloscope	--	1
09.	Connecting Board	--	1
10.	Connecting Wires	--	--

Procedure :- **a) For Characteristics of UJT**

01. The connections are made as shown in the circuit diagram.
02. With the voltage varying knobs of the power supply at minimum positions the power supply is switched ON.
03. The value of V_{BB} is adjusted to some convenient value.
04. Keeping V_{BB} constant, V_{EE} is varied in steps and for each step V_{BE} and I_E are noted.
05. V_{EE} is varied until the pointer of the voltmeter kicksback and the value of V_{BE} and I_E are noted at that point.
06. V_{EE} is further varied in steps and the corresponding values of I_E are noted.
07. Step Nos. 3 to 6 are repeated for different values of V_{BB}.
08. The voltage varying knobs are brought back to their minimum positions and the power supply is switched OFF.
09. A curve of V_{BE} vs. I_E is plotted for different values of V_{BB}.
10. The points V_P, V_V, I_P, and I_V are marked on the curve

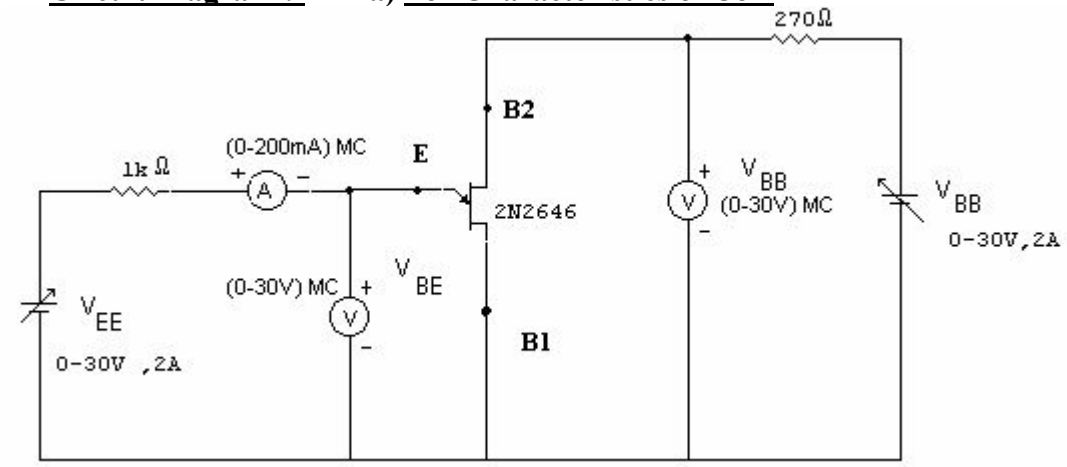
b) For UJT as a Relaxation Oscillator

1. The connections are made as shown in the circuit diagram.

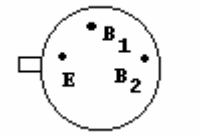
2. With the voltage varying knobs of the power supply at minimum positions the power supply is switched ON.
3. The value of V_{BB} is adjusted to 10 V and the value of resistance R is varied between 10 KΩ and 20 KΩ.
4. The waveform across the capacitor is observed on the CRO and traced.
5. The time constant $T_{Practical}$ is calculated.
6. The values of $T_{Theoretical}$ are calculated and the values of $T_{Practical}$ are noted down for different values of R.
7. The output waveform across the resistor R_1 is observed on the CRO and traced.

8. The voltage varying knobs are brought back to their minimum positions and the power supply is switched OFF.

Circuit Diagram :- **a) For Characteristics of UJT**



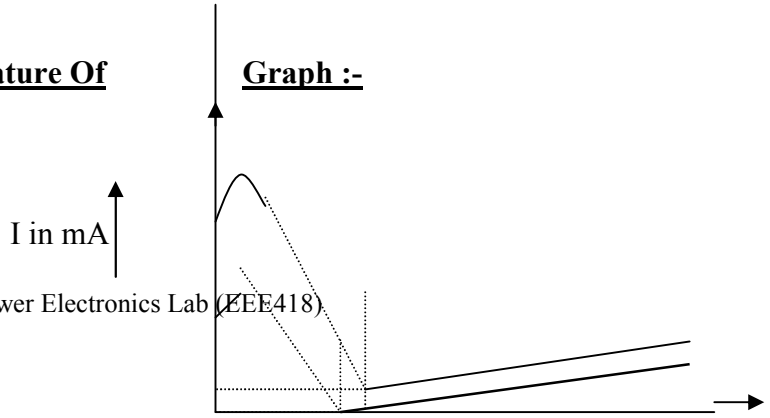
Lead Identification:- For 2N2646 The terminal near to projection is emitter.



Tabular Column :-

Sl.No.	V_{BB} = 0 V		V_{BB} = 5 V		V_{BB} = 10 V	
	V_{BE} in volts	I_E in mA	V_{BE} in volts	I_E in mA	V_{BE} in volts	I_E in mA

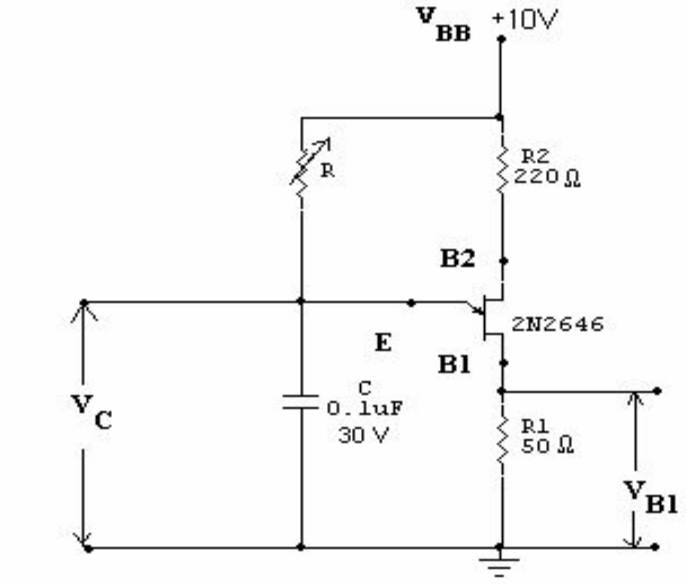
Nature Of Graph :-



$V_{BB} = 0V$

V in volts

Circuit Diagram :- **b) For UJT as a Relaxation Oscillator**



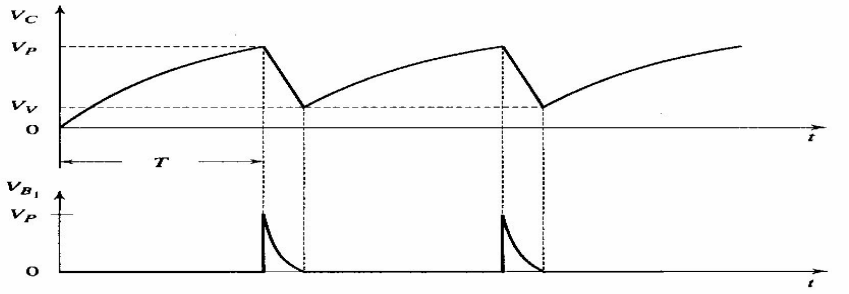
Design Equations :-

$$T = RC \ln\left(\frac{1}{1-\eta}\right) \quad ; \quad \text{where } \eta \text{ is the Intrinsic stand-off ratio.}$$

Tabular Column :-

Sl.No	R in ohms	$T_{PRACTICAL}$ in secs	$T_{THEORITICAL}$ in secs

Nature Of Graph :-



Viva - Voce questions:

1. Name some of the triggering methods to SCRs?
2. What is the range of firing angle in case of 1. R- triggering 2. R-C triggering 3. UJT triggering?
3. What is the function of diode in R-C triggering circuit?
4. What is the difference between the UJT triggering and R-C triggering?
5. Why R- triggering is not popular?
6. Why UJT is called as relaxation oscillator?
7. In UJT relaxation oscillator, what is the effect of charging resister on firing angle?
8. What is the approximate formula for charging time of capacitor in UJT relaxation oscillator?
9. What is the range of η in UJT?
10. What is meant by programmable unijunction transistor (PUT)?

EXPT.NO. - 4. SINGLE PHASE UNCONTROLLED RECTIFIERS

Aim : - *1. To observe the waveforms and determine the ripplefactor of single* **phase uncontrolled halfwave and fullwave rectifiers.**

2. To determine the ripplefactor of single phase uncontrolled bridge rectifier and observe the waveforms with and without filter.

Apparatus : -

Sl.No.	APPARATUS	RANGE	QTY
01.	Single phase Dimmerstat	230/0-270V, 10A	1
02.	Isolation transformer with center tap	240/240V, 5A	1
03.	Power diodes	SPR12M	4
04.	Resistor	600Ω, 1.7A	1
05.	Voltmeter	(0-100V) MI	1
06.	Capacitor	50 μF	1
07.	Inductor	1.4H	1
08.	Cathode ray oscilloscope	--	1
09.	Differential Module	--	1
10.	Connecting board	--	1
11.	Connecting wires	--	1

Procedure : -

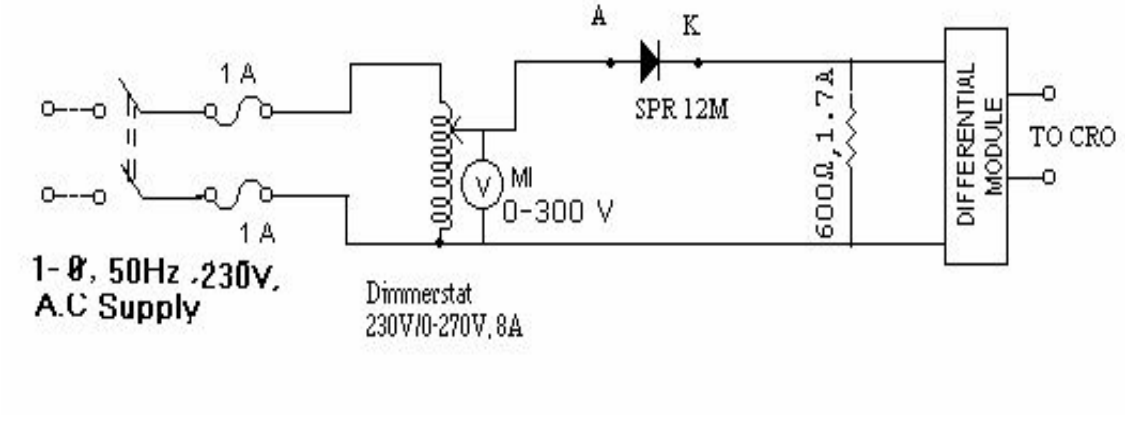
01. The connections are made as shown in the circuit diagram for a halfwave rectifier.

02. With the Dimmerstat at zero output position, the supply switch is closed and the

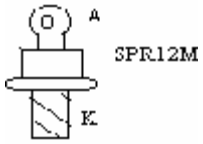
CRO is switched ON.

03. The Dimmerstat is varied in steps such that the V_{max} values are adjusted to the values given in the tabular column using CRO.
04. The DC value of the voltage is also measured from the CRO.
05. The input and output waveforms are traced.
06. The Dimmerstat is brought back to zero output, the supply switch and the CRO are switched OFF.
07. The value of V_{rms} is calculated and entered into the tabular column. The value of ripple factor is calculated and compared with the theoretical value.
08. Step Nos. 1 to 7 are repeated for a fullwave rectifier with centre tap transformer.
09. Step Nos. 1 to 7 are also repeated for a fullwave bridge rectifier.
10. The output waveform for bridge rectifier is observed by connecting a filter circuit as shown in the circuit diagram.

Circuit Diagram :- **a) For Halfwave Rectifier**



Lead Identification :- For SPR12M



Tabular Column :-

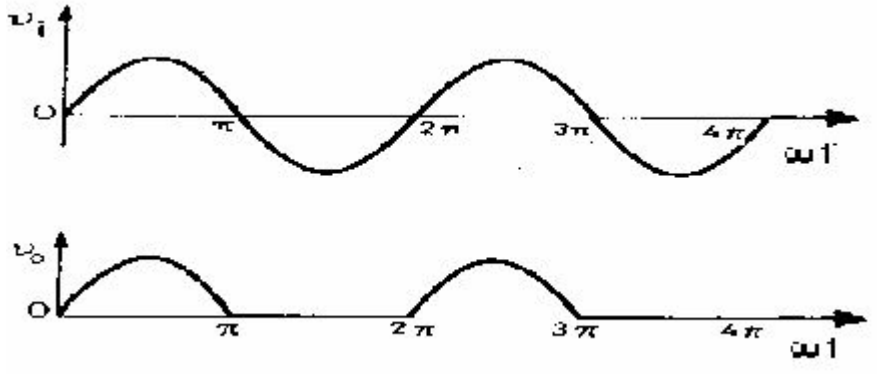
Sl.No.	V_m in volts	V_{rms} in volts	V_{dc} in volts		Ripple factor	
			Calculated	Measured	Theoretical	Calculated from measured values

1. 2. 3.	100 120 140				1.21	

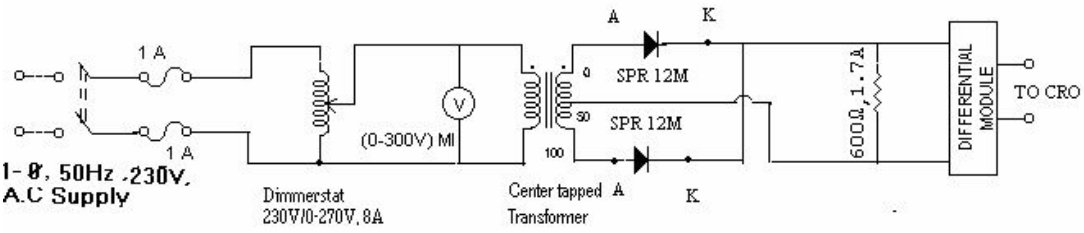
Specimen calculation :-

1) $V_{rms} = V_m / 2$; 2) $V_{dc} = Vm / \Pi$; 3) Ripple Factor = $\sqrt{\left(\left[\frac{V_{rms}}{V_{dc}}\right]^2 - 1\right)}$

Waveforms :-



Circuit Diagram :- **b) For Fullwave Rectifier**



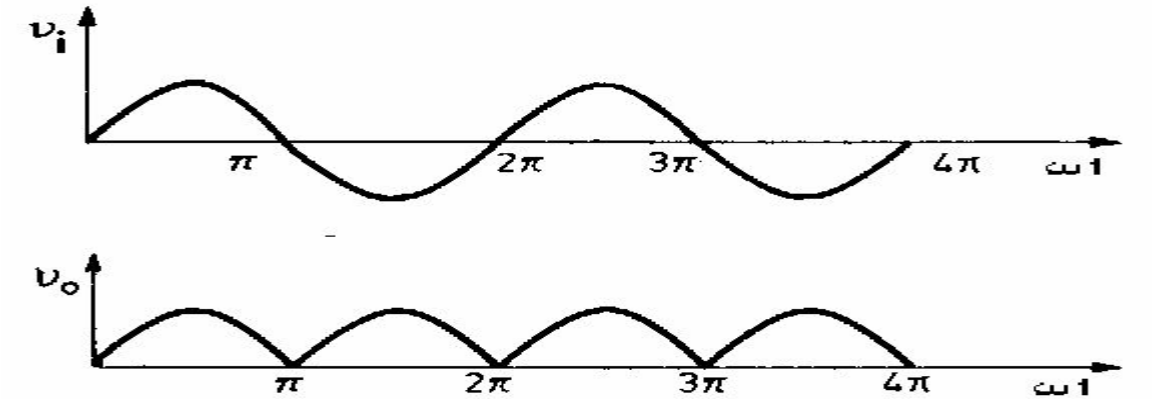
Tabular Column :-

Sl.No.	V_m in volts	V_{rms} in volts	V_{dc} in volts		Ripple factor	
			Calculated	Measured	Theoretical	Calculated from measured values
1. 2. 3.	100 120 140				0.482	

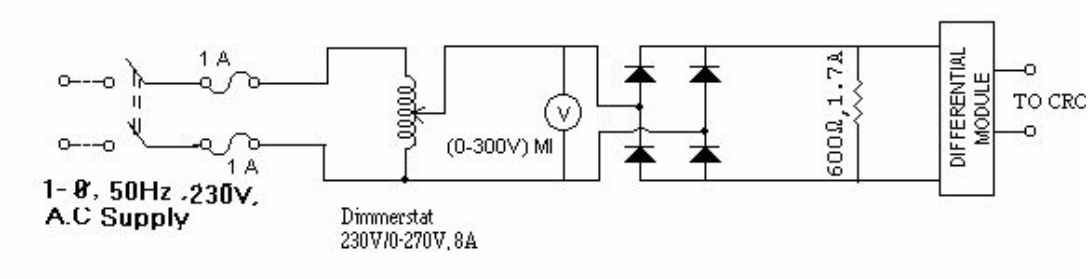
Specimen Calculation :-

1) $V_{rms} = V_m / \sqrt{2}$; 2) $V_{dc} = 2Vm / \Pi$; 3) Ripple Factor = $\sqrt{\left(\left[\frac{V_{rms}}{V_{dc}}\right]^2 - 1\right)}$

Waveforms :-



Circuit Diagram :- **c) For Bridge Rectifier without Filter**



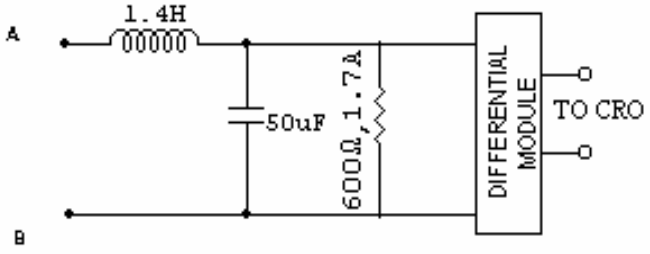
Tabular Column :-

Sl.No.	V_m in volts	V_{rms} in volts	V_{dc} in volts		Ripple factor	
			Calculated	Measured	Theoretical	Calculated from measured values
1. 2. 3.	100 120 140				0.482	

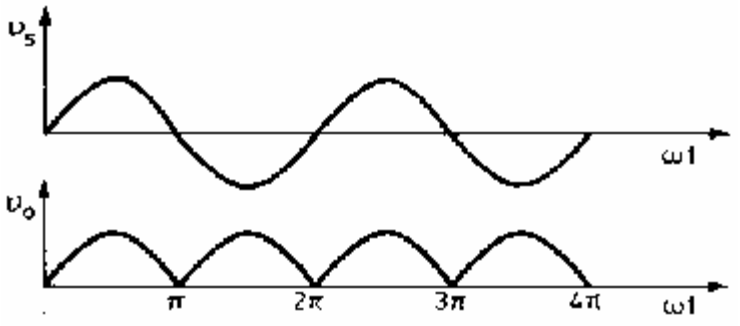
Specimen Calculation :-

1) $V_{rms} = V_m / \sqrt{2}$; 2) $V_{dc} = 2Vm / \Pi$; 3) Ripple Factor = $\sqrt{\left(\left[\frac{V_{rms}}{V_{dc}}\right]^2 - 1\right)}$

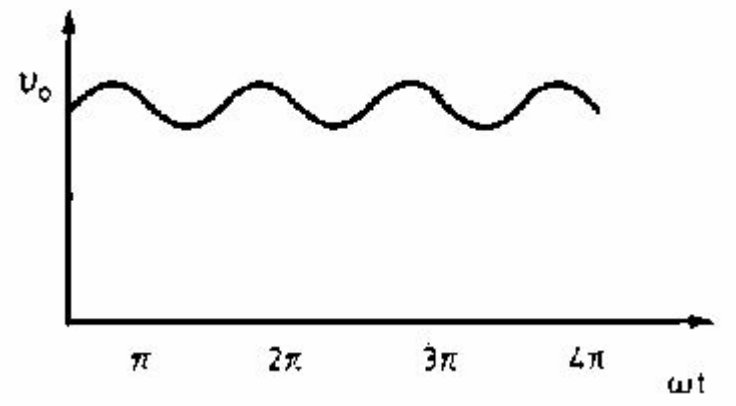
Circuit Diagram :- **d) For Bridge Rectifier with Filter**



Waveforms :- **a) Without filter**



b) With filter



Viva - Voce questions:

1. Define efficiency of rectification?
2. Define form factor and ripple factor for rectifier?
3. Define displacement power factor, harmonic factor (HF) for rectifier?
4. Define transformer utilization factor (TUF)?
5. In a single phase bridge rectifier, what is PIV rating of diode?
6. What is the ripple factor of centre tapped full-wave rectifier?
7. What is the PIV rating of SCR in centre tapped full- wave controlled rectifier?
8. What is the purpose of Zig- Zag secondary of a rectifier transformer?
9. What is the main difference between half wave and full wave rectifier circuits?
10. What are the disadvantages of full wave bridge rectifier?

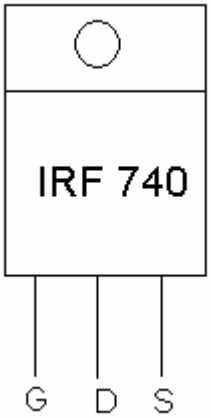
EXPT.NO. – 5. **MOSFET CHOPPER**.

Aim :- To set up and study the operation of a power MOSFET Chopper.

Apparatus :-

Sl.No.	APPARATUS	RANGE	QTY
1.	Power MOSFET chopper module.	--	1
2.	D.C.Powersupply	0 – 30 V, 2 A.	1
3.	Cathode Ray Oscilloscope	--	1
4.	Rheostat.	600Ω, 1.7 A.	1
5.	Voltmeter	(0 – 30 V) MC	1
6.	Patch chords.	--	--

Lead Identification:

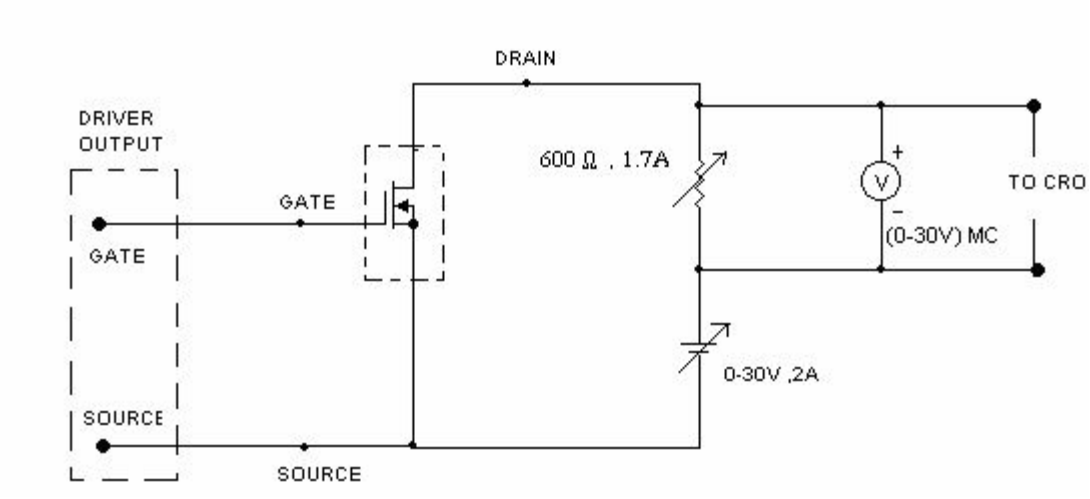


Procedure :-

1. The connections are made as shown in the circuit diagram.
2. The driver output of Gate and Source are connected to the power MOSFET.
3. The power switch of chopper module and D.C.powersupply are switched ON.
4. The output of D.C powersupply is adjusted to 25 volts and the CRO is switched ON.
5. With the power circuit switch of chopper module moved to ON position, the ON/OFF push button switch is switched ON and the load voltage is observed.

6. The duty cycle is maintained constant, the frequency is varied in steps, the readings are noted for each step in the tabular column and the waveforms are also traced.
7. The frequency is maintained constant, the duty cycle is varied in steps, the readings are noted for each step in the tabular column and the waveforms are also traced.
8. The ON/OFF push button switch is switched OFF and power circuit switch of chopper module is also moved to OFF position.
9. The D.C.powersupply is brought back to zero output and all the power switches are switched OFF.

Circuit Diagram :-



Tabular Column :- **a) For Fixed Duty cycle**

Input voltage V_{in} = 25 v

Sl.No.	V_o in volts measured	T_{on} in msec	T_{off} in msec	Frequency in Hz	% Duty cycle calculated	V_o in volts calculated

b) For Fixed Frequency

Input voltage V_{in} = 25 v

Sl.No.	V_o in volts measured	T_{on} in msec	T_{off} in msec	Frequency in Hz	% Duty cycle calculated	V_o in volts calculated

Specimen Calculations :-

1) $T = T_{on} + T_{off}$; 2) $f = 1 / T$; 3) $\delta = T_{on} / T$;

4) % Duty cycle = (T_{on} / T) x 100 ; 5) $V_o = V_{in}$ x δ ;

Waveforms : - **For a particular frequency**

a) At 10% Duty cycle

b) At 50% Duty cycle

c) At 80% Duty cycle

Viva - Voce questions:

1 Mention one advantages of power MOSFET over Power transistor?
2 Distinguish between Depletion and Enhancement MOSFET?
3 In what respect JFET differs from MOSFET?
4 Is the FET a voltage controlled device or current controlled device?
5 What are the disadvantages of FET's?
6 What is Pinch-off voltage in FET?
7 What is IGFET?
8 Give the classification of MOSFET?
9 Why the FET possess low noise?
10 Is the FET a Unipolar device or Bipolar device?

EXPT.NO. – 6. D.C. CHOPPER

Aim :- To set up and study the operation of an auxiliary commutated D.C.Chopper.

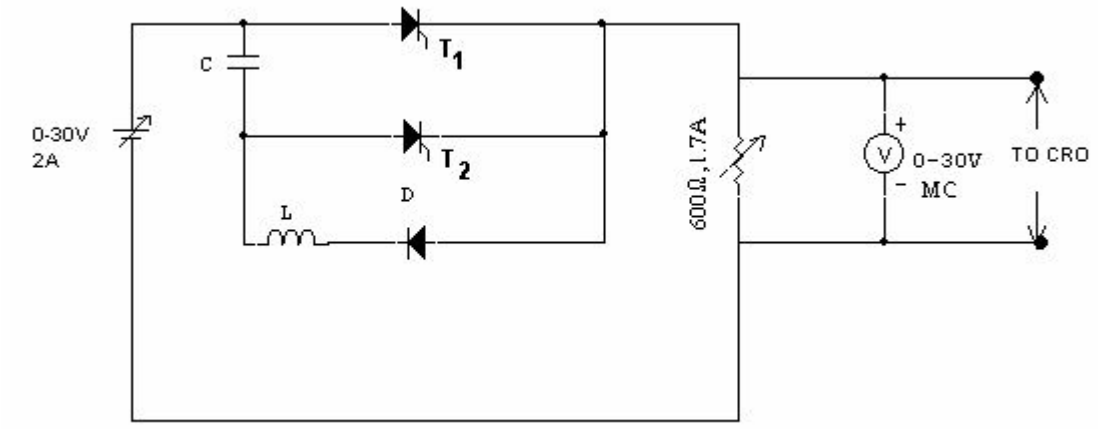
Apparatus :-

Sl.No.	APPARATUS	RANGE	QTY
1.	D.C. Chopper Module	--	1
2.	D.C. Chopper firing circuit module	--	1
3.	D.C.Powersupply	(0 – 30 V), 2 A	1
4.	Cathode Ray Oscilloscope	--	1
5.	Rheostat	600Ω, 1.7 A.	1
6.	Voltmeter	(0 – 30 V)MC	1
7.	Patch chords	--	--

Procedure :-

01. The power circuit connections are made as shown in the circuit diagram.
02. The outputs of T_M and T_A on the firing unit are connected to the Gate and Cathode of the respective thyristors T_1 and T_2 on the power circuit.
03. The power switch of firing unit, supply switch of power supply, and the switch of power circuit are switched ON.
04. The output of D.C powersupply is adjusted to 25 volts and the CRO is switched ON.
05. The ON/OFF push button switch on the firing unit is switched ON so that the firing pulses can be applied to the thyristor gates.
06. The voltage across the load is observed.
07. With the duty cycle adjusted to 10 % the frequency of the firing pulses is varied in steps and the values of V_o, T_{on} and T_{off} are noted for each step.
08. Step No. 7 is repeated for duty cycles of 50 % and 80 %.
09. The output waveforms for a particular frequency and duty cycles of 10 %, 50 % and 80 % are traced.
10. The ON/OFF push button switch on the firing unit is switched OFF, the output of D.C powersupply is brought back to zero output and all the power switches are switched OFF.

Circuit Diagram :-



Tabular Column :- **a) For 10 % Duty Cycle**

Input voltage V_{in} = 25v

Sl.no	V_o in volts measured	T_{on} in msec	T_{off} in msec	Frequency in Hz	% Duty cycle calculated	V_o in volts calculated

b) For 50 % Duty cycle

Input voltage V_{in} = 25v

Sl.no	V_o in volts measured	T_{on} in msec	T_{off} in msec	Frequency in Hz	% Duty cycle calculated	V_o in volts calculated

c) For 80 % Duty cycle

Input voltage V_{in} = 25v

Sl.no	V_o in volts measured	T_{on} in msec	T_{off} in msec	Frequency in Hz	% Duty cycle calculated	V_o in volts calculated

Specimen Calculations :-

1) $T = T_{on} + T_{off}$; 2) $f = 1 / T$; 3) $\delta = T_{on} / T$

4) % Duty cycle $= (T_{on} / T) \times 100$; 5) $V_o = V_{in} \times \delta$;

Waveforms :- **For a particular frequency**

d) At 10% Duty cycle

e) At 50% Duty cycle

f) **At 80% Duty cycle**

Viva -Voce questions:

1. What is chopper?
2. What is purpose of the freewheeling diode in d.c chopper?
3. What is draw back of frequency modulated chopper?
4. What is purpose of diode in regenerative or type B chopper?
5. Why additional inductor is not necessary for commutation in Load commutation circuit?
6. What is the purpose of diode in series with the inductor of voltage commutation circuit ?
7. What are the application of D.C. chopper?
8. What are the disadvantages of d.c chopper?
9. What is the purpose of free- wheeling diode in the case of a d.c chopper?
10. What is meant by time control ratio (duty ratio) of a d.c chopper?
11. Why Thyristors are not preferred for inverters and chopper?

EXPT.NO. –7. SINGLE PHASE CONTROLLED RECTIFIERS

Aim :- To study the variation of output voltage with variation in firing angle for R and R-L load in case of halfwave and fullwave rectifiers.

Apparatus :-

Sl.No.	APPARATUS	RANGE	QTY.

1.	SCR modules	-	4
2.	ITC 08	-	1
3.	Single phase Dimmerstat	0-270V, 10A	1
4.	Isolation Transformer	-	1
5.	CRO	-	1
6.	Rheostat	600Ω , 1.7A	1
7.	Inductor	250mH, 2A	1
8.	Voltmeter	(0–300V)MI and(0-300V)MC	1each
9.	Differential Module	-	1
10.	Patch Chords	-	-

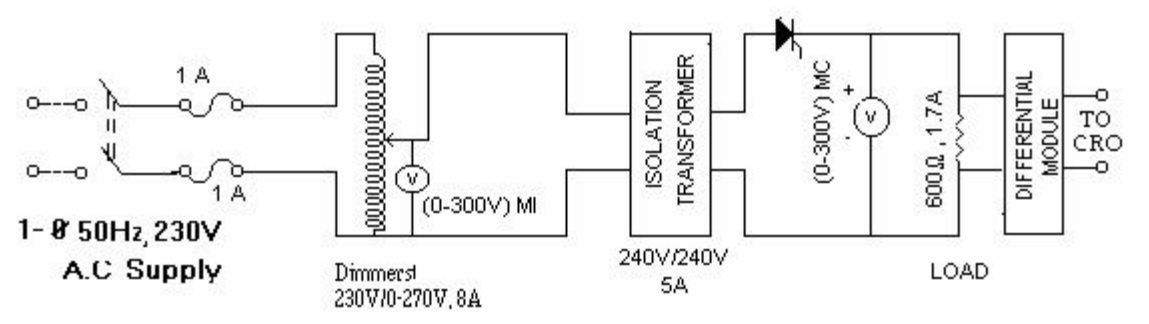
Procedure :- **a) For Halfwave rectifier**

1. The connections are made as shown in the circuit diagram.
2. The output of T_1 of ITC 08 is connected to the gate and cathode of the thyristor.
3. With the Dimmerstat at zero output, the main supply switch, the CRO, the differential module and the power switch of ITC 08 are switched ON.
4. Using the select switch the working mode of ITC 08 is set to 1PhCON so that ITC 08 will be suitable to trigger a single phase converter power circuit. The DEC switch is pressed and the firing angle display is set to 0^0.
5. **The Dimmerstat output is adjusted to 100 volts and the RUN/STOP switch is pressed to supply the firing pulses to the thyristor.**
6. The output waveform is observed on the CRO.
7. The firing angle is varied in steps of 10^0 using the INC switch and the voltmeter reading is noted for each step.
8. The waveforms at firing angles of 0^0 , 90^0 and 150^0 only are to be traced.
9. The RUN/STOP switch is pressed to stop the supply of firing pulses to the thyristor, the Dimmerstat is brought back to zero output, all the power and main supply switches are switched OFF.
10. The above procedure is repeated with R-L load.

b) For Fullwave rectifier

1. The connections are made as shown in the circuit diagram.
2. The outputs of T_1, T_2, T_1^1 and T_2^1 of ITC 08 are connected to the respective gate and cathode of thyristors T_1, T_2, T_1^1 and T_2^1 on the power circuit.
3. Steps Nos. 3 to 10 of Halfwave rectifier are repeated.

Circuit Diagram :- a) Halfwave Rectifier



Tabular Column :- **a) With R load**

V_{ph} = 100 volts

Sl.No.	Firing angle in Degrees	V_{dc} in volts

b) With R- L load

V_{ph} = 100 volts

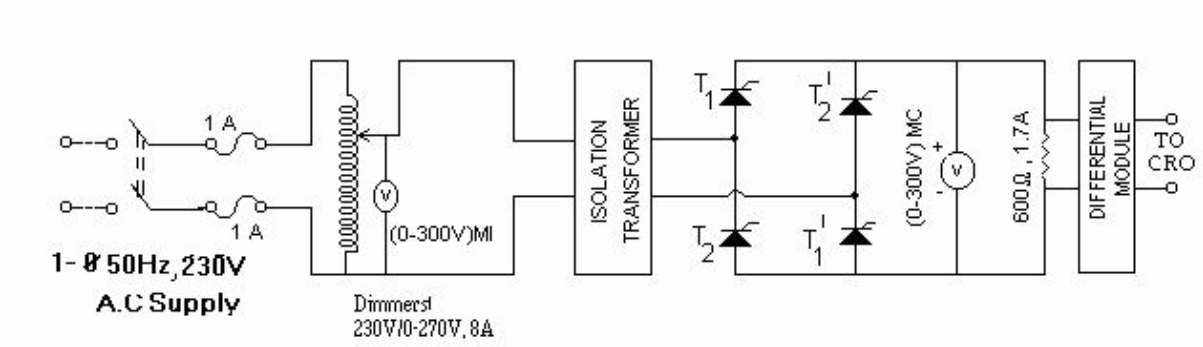
Sl.No.	Firing angle in Degrees	V_{dc} in volts

Wave forms :- **a) With R-load** **b) With R-L load**

1. **For 0^0**
2. **For 90^0**
3. **For 150^0**

1. **For 0^0**
2. **For 90^0**
3. **For 150^0**

Circuit Diagram :- ***b) Fullwave Rectifier***



Tabular Column :- **a) With R load**

V_{ph} = 100 volts

Sl.No.	Firing angle in Degrees	V_{dc} in volts

b) With R- L load

V_{ph} = 100 voltss

Sl.No.	Firing angle in Degrees	V_{dc} in volts

Wave forms :- **a) With R-load** **b) With R-L load**

1. **For 0^0**
2. **For 90^0**
3. **For 150^0**

1. **For 0^0**
2. **For 90^0**
3. **For 150^0**

Viva-Voce questions:

1. What is the basic function of the rectifier circuit?
2. Why are the rectifier circuits use thyristors called controlled rectifiers?
3. Classify the single phase controlled rectifier circuits?
4. What is meant by PIV Value?
5. What are the uses of the Freewheeling Diode? Where it is connected?
6. What is the expression for the average output voltage with R-Load for a halfwave rectifier?
7. What is the expression for the average output voltage with R-Load for a Fullwave bridge rectifier?
8. Which rectifier circuit is also called one pulse rectifier?
9. In a controlled rectifier circuit how is the output voltage varied?
10. Mention some applications of controlled rectifier circuits?

EXPT.NO. – 8. SINGLE PHASE CYCLOCONVERTER

Aim : - To set up and study the operation of a single phase centre tap transformer type Cycloconverter.

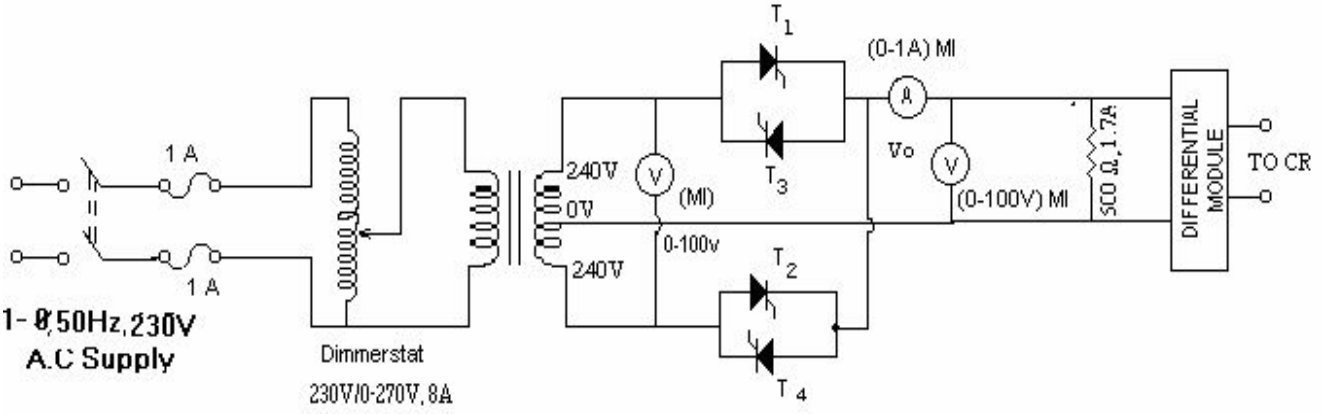
Apparatus: -

Sl.No.	APPARATUS	RANGE	QTY
01.	Single phase Cycloconverter power circuit	--	1
02.	Single phase Cycloconverter firing unit	--	1
03.	Single phase Dimmerstat	0–270V, 10A	1
04.	Single phase Centre tap transformer	2 KVA, 1:2	1
05.	Cathode Ray Oscilloscope	--	1
06.	Differential Module	--	1
07.	Ammeter	(0 – 1 A)MI	1
08.	Voltmeter	(0–100 V)MI	1
09.	Rheostat	600Ω, 1.7 A	1
10.	Patch Chords	--	1

Procedure : -

1. The power circuit connections are made as shown in the circuit diagram.
2. The output of T_1, T_2, T_3 and T_4 on the firing unit is connected to the gate and cathode of the respective thyristors on the power circuit.
3. With the output of Dimmerstat at zero output the supply switch is closed, the CRO, the MCB of the power circuit and power switch of firing unit are switched ON.
4. The Dimmerstat output is adjusted to 100V with the frequency division thumb wheel at position – 2 ; the ON/OFF push button switch of firing unit is switched ON.
5. The firing angle is varied in steps and for each step the output waveform is observed and the readings are tabulated in to the tabular column.
6. Before changing the frequency division to the next value the ON/OFF push button switch of the firing unit is switched OFF.
7. The frequency division switch is varied in steps from 2 to 9 and for each step the firing angle is varied from minimum to maximum, the output waveforms are observed and the required readings are tabulated into the tabular column.
8. The output waveforms for a particular firing angle for different frequency divisions are traced.
9. The ON/OFF push button switch of the firing unit is switched OFF, the Dimmerstat is brought back to zero output and all the switches are switched OFF.

Circuit Diagram : -



Tabular Column :-

Input Voltage V_{in} = 100 v

Sl.No.	Frequency division	Firing angle in degrees	V_o in volts	I_o in amperes

Waveforms : - **For a particular firing angle**

a) At frequency division-2

b) At frequency division-3

c) At frequency division-4

d) At frequency division-5

e) At frequency division-6 or 7

f) At frequency division-8

g) At frequency division-9

Viva–Voce question:

1. What is the basic function of the rectifier circuit?
2. Why are the rectifier circuits use thyristors called controlled rectifiers?
3. Classify the single phase controlled rectifier circuits?
4. What is meant by PIV Value?
5. What are the uses of the Freewheeling Diode? Where it is connected?
6. What is the expression for the average output voltage with R-Load for a halfwave rectifier?
7. What is the expression for the average output voltage with R-Load for a Fullwave bridge rectifier?
8. Which rectifier circuit is also called one pulse rectifier?
9. In a controlled rectifier circuit how is the output voltage varied?
10. Mention some applications of controlled rectifier circuits?

EXPT. NO. – 9. THREE PHASE FULLY CONTROLLED RECTIFIER.

Aim : - To study the variation of output voltage with variation in firing angle for a three phase fully controlled bridge converter.

Apparatus : -

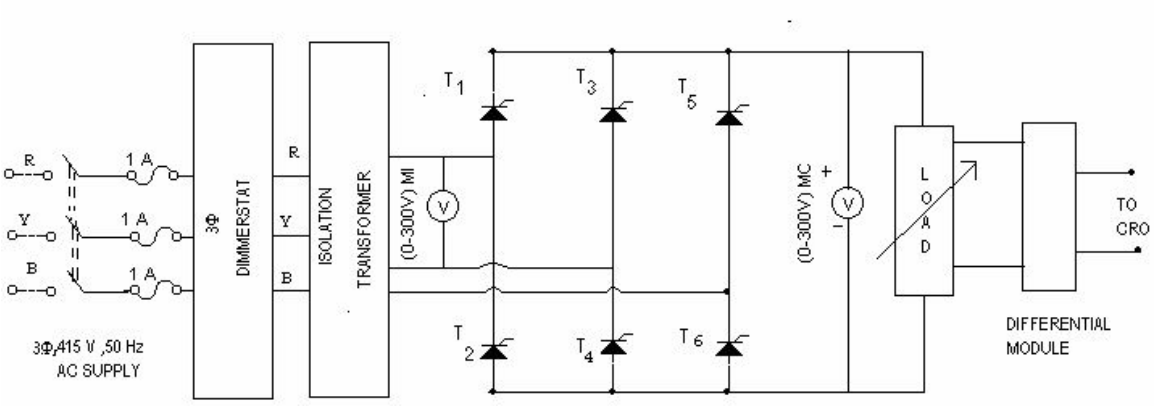
Sl.No.	APPARATUS	RANGE	QTY
1.	Three phase fully controlled converter power circuit.	--	1
2.	Three phase converter-firing circuit	--	1
3.	Three phase Dimmerstat	0 – 415 V, 10A	1
4.	Cathode Ray Oscilloscope	--	1
5.	Differential module	--	1
6.	Isolation Transformer	--	1
7.	Rheostat.	600Ω, 1.7 A	1
8.	Inductor	250mH, 2A	1
9.	Voltmeter	(0 – 300 V)MC	1
10	Voltmeter	(0-300V) MI	1
11.	Patch chords	--	

Procedure :-

1. The power circuit connections are made as shown in the circuit diagram.
2. The outputs of T_1, T_2, T_3, T_4, T_5 and T_6 on the firing unit are connected to the gate and cathode of the respective thyristors on the power circuit.
3. With the three phase Dimmerstat at zero output the main supply switch, the CRO and power switch of firing unit are switched ON.
4. The Dimmerstat output is adjusted to 100 volts; the MCB of power circuit is switched ON.
5. The ON/OFF push button switch of the firing unit is switched ON and the output waveform is observed on the CRO.
6. The firing angle is varied in steps from 30^o to 120^o and the waveforms are traced for different firing angles. The variation of output voltage from minimum value to maximum is also observed.
7. Step No:4,5, and 6 are repeated with R-L Load.
8. The ON/OFF push button switch of the firing unit is switched OFF, the Dimmerstat is

brought back to zero output and all the power and supply switches are switched OFF.

Circuit Diagram :-



Tabular Column :-

Sl.No.	Firing anglein degrees	For R Load V_{dc} in volts	For R-L Load V_{dc} in volts
1	30		
2	40		
3	50		
4	60		
5	70		
6	80		
7	90		
8	100		
9	110		
10	120		
11	130		
12	140		
13	150		
14	160		
15	170		

16	180		

Waveforms :-

a) With R-load

1. For 0^0
2. For 60^0
3. For 90^0
4. For 110^0

b) With R-L load

1. For 0^0
2. For 60^0
3. For 90^0
4. For 110^0

Viva-Voce questions

1. What is the function of converter circuit?
2. Classify the Three phase converter circuits?
3. How many Thyristors will conduct at a time in Three phase halfwave converter?
4. For the above question What is the condition for the conduction of SCR's?
5. How many Thyristors will conduct at a time in Three phase fullfwave converter?
6. For the above question What is the condition for the conduction of SCR's?
7. What is the number of pulses a semiconverter have in its output waveform?

8. Which converter is called three pulse converter?
9. Which converter is called six pulse converter?
10. How many SCR's are used in 12 pulse converter?
11. In a three phase converter how the output voltage is varied?
12. Mention some applications of converter circuits?

EXPT.NO. –10. SERIES INVERTER

Aim :- To study the operation of a modified series inverter

Apparatus :-

Sl.No.	APPARATUS	RANGE	QTY
1.	Series inverter power circuit module	--	1
2.	Series inverter firing circuit module	--	1
3.	DC powersupply	0-30V, 2A	1
4.	Rheostat	230Ω , 1.7 A	1
5.	Cathode ray oscilloscope	--	1
6.	Multimeter	--	1
7.	Patch chords	--	1

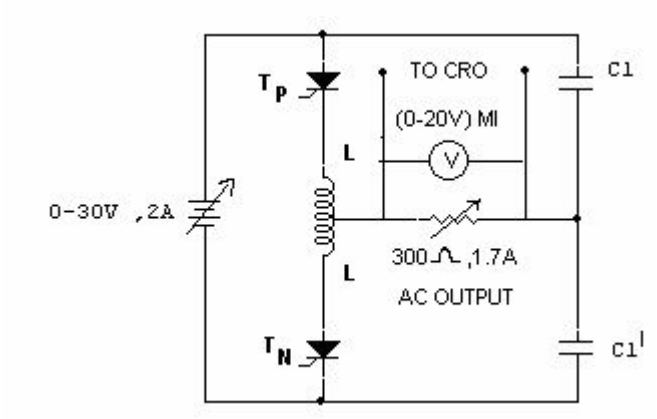
Procedure :-

01. The power circuit is as shown in the circuit diagram.
02. The DC power supply connections are given to the terminals marked DC input ensuring that the power circuit is in OFF position.
03. The rheostat is connected across the terminals marked AC output as well as a voltmeter and a CRO.
04. The firing unit is given AC supply ensuring that the main switch and toggle switch
are in OFF position.
05. The terminals T_P and T_N of firing circuit are connected to the terminals T_P and T_N of power circuit. These connections provide firing pulses to the thyristors T_P and T_N .
06. The DC power supply is switched ON and the output is adjusted to 25V. The rheostat is adjusted such that its value will be around 75Ω.
07. With the frequency knob of the firing circuit at minimum position, the main switch

is switched ON and the toggle switch is also switched ON.

08. The output waveform is observed on the CRO.
09. The waveforms are traced at minimum frequency, mid frequency and maximum frequency.
10. The frequency at the above three positions is measured with the help of CRO and
    the corresponding output voltages are also noted.
11. The frequency knob is brought back to minimum position; the toggle switch and main switch of firing circuit are switched OFF.
12. The voltage knobs of DC power supply are brought back to their minimum positions and the main switch of firing circuit as well as DC powersupply is switched OFF.

Circuit Diagram :-



Tabular Column : -

Sl.No.	Frequency inHz	Output voltage in volts

Waveforms :-

For different frequencies

a)

b)

c)

Viva-Voce questions:

1. What are the necessary features of SCRs used for inverters?
2. What is the purpose of feedback diodes in voltage source inverter?
3. What type of commutation is used in MC- mercury Bed- ford inverter?
4. In a circuit, 3 SCRs are triggered sequentially, later one SCR is triggered at a time. Then what is the Mode of this inverter?
5. A constant current source supplies 50mA current to a load of 1KΩ. if the load is changed to 500Ω, Determine the current ?
6. For less harmonics in output voltage what type of modulation is used in inverters?
7. What is the purpose of PWM in inverter?
8. What is the purpose of feed back diodes in bridge inverter?
9. Why modulation index is kept less than 1 in PWM?
10. In basic series inverter why output maximum frequency is below the resonant frequency?
11. How do you eliminate 3^{rd} harmonic in 3- phase square wave inverter?
12. For what frequency series inverter is used ?
13. What are the disadvantages of Transistor inverter over SCR inverters?What are the advantages of Transistor inverter over SCR inverter ?
14. State the application of series inverter?

EXPT.NO.-11. SPEED CONTROL OF A SEPERATELY EXCITED D.C MOTOR

Aim :- To control the speed of a separately excited DC motor using a half controlled converter.

Apparatus :-

Sl.No.	APPARATUS	RANGE	QTY
1.	Single phase half controlled converter circuit power module	--	1
2.	Single phase half controlled converter firing circuit module	--	1
3.	Seperately excited DC motor	0.37kW, 220V, 1500rpm	1
4.	Single phase Dimmerstat	--	2
5.	Isolation transformer	--	1
6.	Multimeter	--	3
7.	DC supply unit	220V, 0.3A	1
8.	Tachometer	Digital	1
9.	Patch chords	--	--

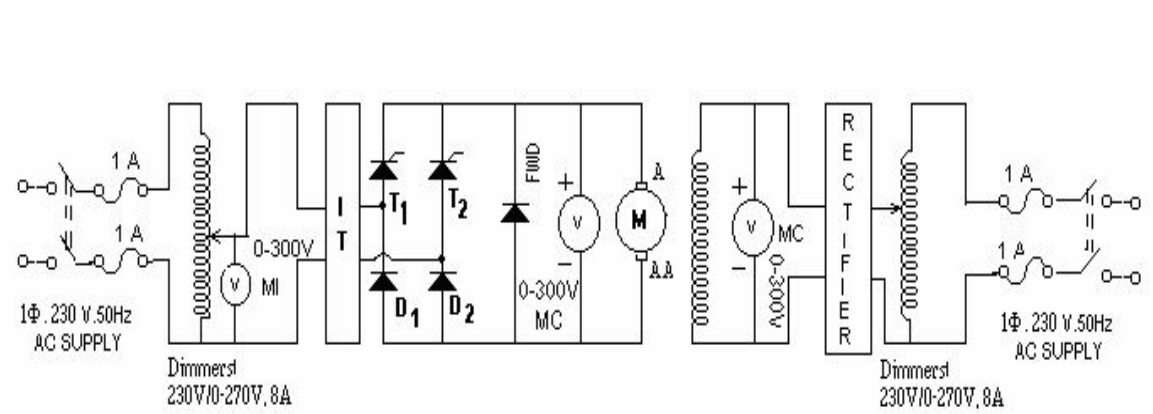
Procedure :-

01. The power circuit connections are made as shown in the circuit diagram.
02. The left hand side Dimmerstat output is connected to the terminals marked AC input of power circuit.
03. The right hand side Dimmerstat is connected to the terminals marked Input 230V AC,50Hz and output of dimmerstat is connected to rectifier as input.
04. The Field terminals of the motor are connected to output DC terminals of DC supply unit.(Rectifier unit).
05. The Armature terminals of the motor are connected to DC output of controlled power circuit.
06. The terminals T_1 and T_2 of the firing circuit are connected to the terminals T_1 and T_2 of power circuit.
07. Ensuring that both the Dimmerstats are at zero output ,their main supply switches are closed.The AC supply is given to the firing circuit ensuring that

its main switch and toggle switch are in OFF position.

08. The output of the DC supply unit connected to the field terminals of motor is adjusted to 220 V with the help of its Dimmerstat.
09. With the main switch of the firing unit is switched ON ensuring that the firing angle varying knob is at 0^0 The output of the left side Dimmerstat connected to the controlled semiconverter is adjusted such that the DC voltage across armature of motor is 220V.
10. The toggle switch of the firing unit is switched ON which makes the DC motor to rotate.
11. The firing angle knob is adjusted to the values given in the tabular column in steps and for each step the speed and armatute voltage are noted.
12. The firing angle knob is brought back to 0^0, the toggle switch and main switch of firing circuit are switched OFF.
13. The Dimmerstats connected to controlled semi converter power circuit and DC supply unit (Rectifier) are brought back to zero output.
14. The main switches of Dimmerstats and the AC supply to firing unit are switched OFF.

Circuit Diagram :-

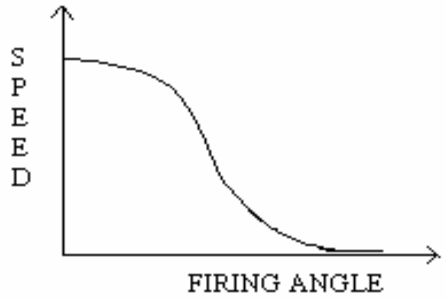


Tabular Column :-

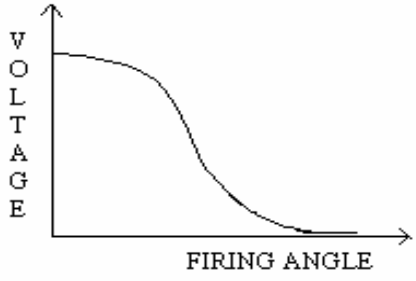
Sl.No.	Firing angle in degrees	Speed in rpm	Armature voltage in volts
1.	0		
2.	30		
3.	45		
4.	60		
5.	90		
6.	120		
7.	135		
8.	150		
9.	180		

Nature of Graph :-

a) Speed Vs Firing angle



b) Armature voltage Vs Firing angle



Viva- Voce questions:

1. What are the different types of D.C. motor speed control?
2. Which method is suitable for speed control below base speed?
3. Which method of speed control has faster response?
4. Name some of the single phase D.C. drive circuits?
5. Which D.C drive circuit is called a one quadrant drive circuit?
6. Which D.C drive circuit is called a two quadrant drive circuit?
7. Why is freewheeling diode connected across the load?
8. At what firing angle of α, will the speed of the motor be maximum?
9. At what firing angle of α, will the speed of the motor be minimum?
10. Mention certain applications of Thyristors based D.C. motor speed control?

EXPT. NO. 12 **CHARACTERSTICS OF MOSFET**

Aim:- 1. Plot the Drain characteristics of a MOSFET
2. Plot the Transfer characteristics of a MOSFET

Apparatus:-

MOSFET	IRF740	1
Resistors	220Ω, 1KΩ	1 each
Milliammeter	0-200mA(MC)	1
Voltmeter	(0-10v) and (0-30v)MC	1 each
D.C Power Supplies	(0-10v) and (0-30v)	1 each
Connecting wires	----------	---

Procedure:-

(a) Drain Characteristics:

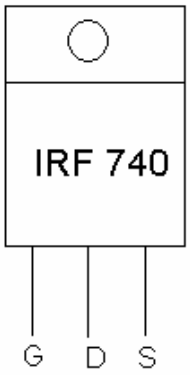
1. The Connections are made as shown in the circuit diagram

2. With the voltages varying knobs of the power supply at minimum positions, the power supply is switched ON.
3. The value of V_{GS} is adjusted to some convenient value.
4. Keeping V_{GS} constant, V_{DS} is varied in steps and for each step I_D is noted.
5. Now step 4 is repeated for different values of V_{GS}.
6. The voltages varying knobs are brought back to their minimum positions and the power is switched OFF.
7. A curve of V_{DS} and I_D is plotted for different values of V_{GS}.

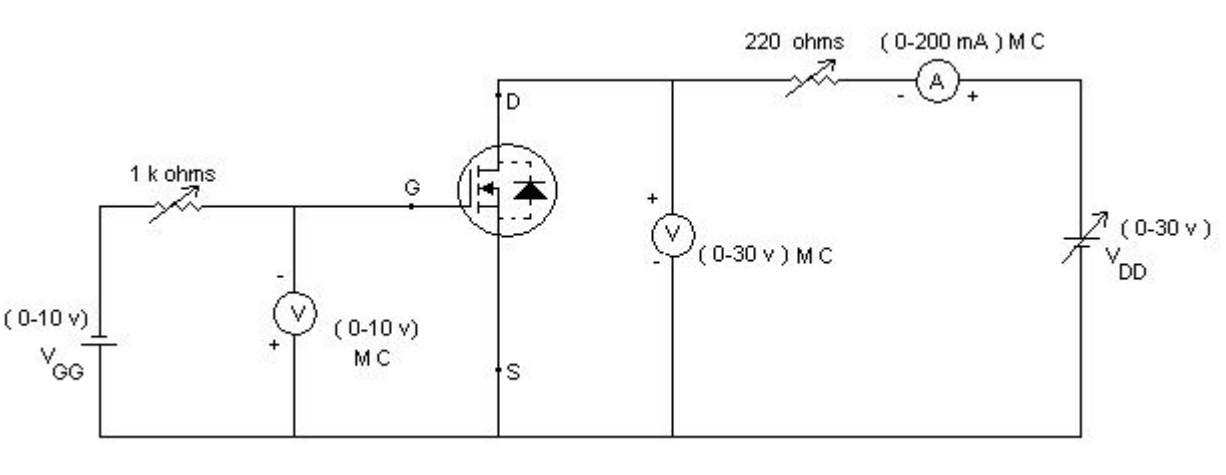
(b) <u>Transfer Characteristics:</u>

1. The Connection are made as shown in the circuit diagram
2. With the voltages varying knobs of the power supply at minimum positions, the power supply is switched ON.
3. The value of V_{DS} is adjusted to some convenient value.
4. By Keeping V_{DS} cnstant, V_{GS} Varied in steps and for each step I_D is noted.
5. The step 4 is repeated for another convenient values of V_{DS}.
6. The voltages varying knobs are brought back to their minimum positions and the power is switched OFF.
7. A curve of V_{GS} and I_D is plotted for two different values of V_{DS}.

<u>Lead Identification:</u>



<u>Circuit Diagram:</u>



Tabular column

a. Drain Characteristics: -

S.No	V_{GS} = 0V		V_{GS} = -3V		V_{GS} = -5V		V_{GS} = -7V		V_{GS} = -10V	
	V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)

b. Transfer Characteristics: -

S.No	V_{DS} = 10V		V_{DS} = 20V	
	V_{GS} (V)	I_D(mA)	V_{GS} (V)	I_D(mA)

Viva- Voce questions:

11 Distinguish between Depletion and Enhancement MOSFET?
12 In what respect JFET differs from MOSFET?
13 Is the FET a voltage controlled device or current controlled device?
14 What are the disadvantages of FET's?
15 What is Pinch-off voltage in FET?
16 What is IGFET?
17 Give the classification of MOSFET?
18 Why the FET possess low noise?
19 Is the FET a Unipolar device or Bipolar device?
10.Mention one advantages of power MOSFET over Power transistor?

IV/IV B.E (EEE) Power Electronics Lab – 415

1. CHARACTERISTICS OF SCR

8. What is the relation between breakdown voltage of SCR and Gate current?

A. With increase in gate current, the breakdown voltage of SCR decreases.

9. Why the number of SCRs connected in parallel provide total rated current less than the sum of individual ratings?

A. All the SCRs connected in parallel may not Turn- on simultaneously.

10. What are the turn – off times of converter grade and inverter grade SCRs?

A. Turn off time of converter grade SCRs is less than 100µs
Turn off time of inverter grade SCRs is less than 25µs

11. On what factors turn off time of SCRs depends?

A Temperature and Forward current.

12. What is the difference between holding current and latching current?

A. Latching current is the minimum current required by SCR to come from OFF state to ON state. Holding current is the minimum current of SCR to keep SCR in ON, even when the gate pulse is removed. Below the holding current SCR will turn – off.

13. Among Holding and Latching Currents which one will be higher?

A. Latching current is more than the holding current.

14. What is the effect of negative gate current on SCR?

A Negative gate current produces additional heat at the gate junction.
The negative gate current does not have control over turn – off time of SCR.

15. What is the core used in pulse transformer?

A. Ferrite core is used to ensure no dc saturation.

16. What type of gate signal is most suitable for SCR ?

A. High frequency pulse train.

17. What is the purpose of transformer in triggering circuit of SCR?

A. For Isolation purpose.

18. State one difference between Thyristors and Triac?

A Thyristors can conduct in only one direction (positive), but triacs conducts the current in both directions (+ve & - ve). Thyristors are three terminal devices. Triac is a three terminal device and it has two SCRs connected in antiparallel inside.

2. UJT AS RELAXATION OSCILLATOR

3. Name some of the triggering methods to SCRs?

A. 1. R- triggering 2. R-C triggering 3. UJT triggering

4. What is the range of firing angle in case of 1. R- triggering 2. R-C triggering 3. UJT triggering?

A. (1) 0-90 (2) 0-180 (3) 0-180

5. What is the function of diode in R-C triggering circuit?

A. Diode ensures the SCR ON only during positive half cycle.

6. What is the difference between the UJT triggering and R-C triggering?

A UJT triggering provides isolation between control circuit and power circuit using pulse transformer.

In R-C triggering isolation between control circuit and power circuit is not possible.

7. Why R- triggering is not popular?

A. The firing angle can be controlled only in the range 0 to 90.

8. Why UJT is called as relaxation oscillator?

A. Most of the times UJT relaxes.

9. In UJT relaxation oscillator, what is the effect of charging resister on firing angle?

A Firing increases with increase in charging resister.

8. What is the approximate formula for charging time of capacitor in UJT relaxation oscillator?

A $T = RC \ln\left(\frac{1}{1-\eta}\right)$ where R is charging resister

C is charging capacitor

η is intrinsic stand-off ratio

9. What is the range of η in UJT?

A. Its range is 0.6 to 0.7

10. What is meant by programmable unijunction transistor (PUT)?

A. Its structure is similar to SCR as shown above the gate terminal is taken from N, instead of P_2.This gate is called anode gate. Its characteristic is similar to SCR. Its rating is 200v, 1A.

3. SINGLE PHASE UNCONTROLLED RECTIFIERS

1. Define efficiency of rectification?

A. $\eta = \frac{p_{dc}}{P_{ac}} = \frac{output\ \ d.c\ \ power}{output\ \ ac\ \ power} = \frac{V_{dc}.I_{dc}}{V_{rms}.I_{rms}}$

2. Define form factor and ripple factor for rectifier?

A Form factor = $\frac{V_{rms}}{V_{dc}}$

Ripple factor = $\frac{V_{ac}}{V_{dc}} = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$

3. Define displacement power factor, harmonic factor (HF) for rectifier?

A. Displacement power factor (DF) is the cosine of angle between fundamental component of input Current and input Voltage.

Harmonic factor (HF) = $\frac{I_h}{I_1} = \sqrt{\left(\frac{I_3}{I_1}\right)^2 - 1}$

Where I_h is harmonic current
I_1 is fundamental current
I_3 is rms total input current

4. Define transformer utilization factor (TUF)?

A It is defined as

$$TUF = \frac{P_{dc}}{m.V_3.I_3}$$

Where V3 is the rms value of transformer phase voltage
I_3 is the total rms current in transformer phase winding
m is the number of phases of transformer
P_{dc} is output d.c power

5. In a single phase bridge rectifier, what is PIV rating of diode?

A Peak value of supply voltage.

6.. What is the ripple factor of centre tapped full-wave rectifier?

A. 0.482

7. What is the PIV rating of SCR in centre tapped full- wave controlled rectifier?

A. Twice the peak value of input voltage

8. What is the purpose of Zig- Zag secondary of a rectifier transformer?

A To avoid d.c saturation of core.

9. What is the main difference between half wave and full wave rectifier circuits?

A In half wave circuit, we get the output only during the half cycle. In case of full wave rectifier, the output is obtained during both the half cycles.

10. What are the disadvantages of full wave bridge rectifier?

A. (i) More number of diodes are required.
(ii) Switching losses will be more.

4. SINGLE PHASE CONTROLLED RECTIFIERS WITH R-LOAD

1. What is the effect of source inductance in a controlled rectifier?

A. It reduces the output voltage of rectifier.
2. For what range of phase angle delay the phase controlled converter operates as inverter?
A Between 90° and 180°.
3. In a semi-controlled bridge rectifier what are the components used?
A. Diodes and SCRs.
4. A single phase full controlled converter is charging a battery from existing a.c mains , what way the Power can be feed to a.c supply again?
A By reversing battery connections and varying alpha between 90^{θ} and 180^{θ}.
5. What is the purpose of fly- wheel(Free- wheeling) diode across inductive load in converter?
A For better commutation.
6. What is the difference between Natural commutation and forced commutation?
A In a.c circuit, the current naturally reduces to zero (Natural commutation or Line commutation). In D.C. circuit current is forced to zero using L and C elements.

7. What are the advantages of Free- wheeling diode?
A. (1) Average voltage is increased (2) power factor improves
8. As per theory, why a free wheeling diode is not required for a semi- converter?
A Semi- converter has inherent Free- wheeling
9. Why regeneration is not possible with semi- converter?
A. Due to presence of unidirectional device, direction of current can not be reversed. So polarity of D.C output voltage can't be reversed , so regeneration is not possible.
10. What are the effects of Overlap?
A 1. Average output voltage reduces 2. Power factor reduces.

11. What is the frequency of ripple in the output of (a) single phase full wave rectifier (b) 3-phase Full wave controlled rectifier or 6 pulse converter (c) 3 pulse controlled rectifier or 3- phase half Controlled rectifier?
A (a) 2f (b) 6f (c) 3f.

Where f is frequency of supply

5. SINGLE PHASE CONTROLLED RECTIFIERS WITH R-L LOAD

1. What is the basic function of the rectifier circuit?
A. It converts ac to dc
2. Why are the rectifier circuits use thyristors called controlled rectifiers?
A. Since the output voltage can be controlled by varying the firing angle.
3. Classify the single phase controlled rectifier circuits?
A. (i)Single phase Halfwave controlled Rectifiers
(ii) Single phase Fullwave controlled Rectifiers
(a) Centre tap or Mid point Fullwave rectifiers
(b) Full controlled Bridge Rectifiers
(c) Half controlled Bridge Rectifiers
4. What is meant by PIV Value?
A. It is the maximum reverse voltage that can be applied to an SCR without any damage to the device.
5. What are the uses of the Freewheeling Diode? Where it is connected?

A. Freewheeling diode provides the continuous path for the load current.
It is connected across the Inductive load.

6. What is the expression for the average output voltage with R-Load for a halfwave rectifier?

A. $V_o = \frac{V_m(1+\cos\alpha)}{\Pi}$

7. What is the expression for the average output voltage with R-Load for a Fullwave bridge rectifier?

A. $V_o = (Vm/2\pi)(1+\cos\alpha)$

8. Which rectifier circuit is also called one pulse rectifier?
A. Halfwave Rectifier
9. In a controlled rectifier circuit how is the output voltage varied?
A. By varying the Firing Angle.
10. Mention some applications of controlled rectifier circuits?
A. Power supplies, Battery chargers, speed control of DC motors etc.

6.DC CHOPPER

1. What is chopper?
A It converts fixed d.c into variable d.c
2. What is purpose of the freewheeling diode in d.c chopper?
A (i) It helps in commutation of main SCR
(ii) When inductive circuits is interrupted high voltages are induced, which damage SCR. To protect t this SCR, free- wheeling diode is used.
(iii) It provides constant current through the load
3. What is draw back of frequency modulated chopper?
A Design of filter is difficult.
4. What is purpose of diode in regenerative or type B chopper?
A It prevents short circuit across d.c supply.
5. Why additional inductor is not necessary for commutation in Load commutation circuit?
A Inductance of load is sufficient for commutation.
6. What is the purpose of diode in series with the inductor of voltage commutation circuit ?
A. It will not allow current in opposite direction, so that polarity of voltage across capacitor useful for Voltage commutation.
7. What are the application of D.C. chopper?
A. (a) Electric locomotives (b) Battery operated cars (c) power supplies.
8. What are the disadvantages of d.c chopper?
A. (i) More switching losses and stress (ii) they use forced commutation
(iii) they produce electromagnetic interference (EMI)
9. What is the purpose of free- wheeling diode in the case of a d.c chopper?
A. A free wheeling diode is used to provide path for the current when the thyristor switch is
OFF, there by avoiding high voltages across switch.
10. What is meant by time control ratio (duty ratio) of a d.c chopper?
A. The ratio of on period to the total time period is known as time control ratio or duty

ratio.

11. Why Thyristors are not preferred for inverters and chopper?

A. Inverters operating at high frequencies require fast acting switch. Thyristors is not preferred since it can operate at low switching frequency of 2 KHz. Thyristors require forced commutation circuit.

7.SERIES INVERTER

1. What are the necessary features of SCRs used for inverters?

A (i) use factor of safety of 2 to 3
(ii) Turn- off time should be minimum
(iii) Use high dv\dt rating SCRs.

2. What is the purpose of feedback diodes in voltage source inverter?

A To pump back the power to the source.

3. What type of commutation is used in MC- mercury Bed- ford inverter?

A. Voltage commutation

4. In a circuit, 3 SCRs are triggered sequentially, later one SCR is triggered at a time. Then what is the Mode of this inverter?

Ans: 180 ̊

5. A constant current source supplies 50mA current to a load of 1KΩ. if the load is changed to 500Ω, Determine the current ?

A Since constant current source supplies constant current, so current is 50mA

6. For less harmonics in output voltage what type of modulation is used in inverters?

A Multiple PWM

7. What is the purpose of PWM in inverter?

A To reduces harmonics and voltage control

8. What is the purpose of feed back diodes in bridge inverter?

A To pump reactive current to the d.c source

9. Why modulation index is kept less than 1 in PWM?

A To reduces harmonics in the output.

10. In basic series inverter why output maximum frequency is below the resonant frequency?

A Due to the dead band

11. How do you eliminate 3^{rd} harmonic in 3- phase square wave inverter?

A. By connecting system in star or use 120 mode

12. For what frequency series inverter is used ?

A. At high frequencies.

13. What are the advantages of Transistor inverter over SCR inverter ?

A (i) High frequency operation (ii) commutation circuit is not necessary
(iii) Fast response and less harmonics

14. What are the disadvantages of Transistor inverter over SCR inverters?

A. (i) Requires continuous base current (pulse) since BJT is not self latching device
(ii) Requires driving circuit.

15. State the application of series inverter?

A (i) Variable speed ac motor drives
(ii) Induction heating
(iii) Stand by power supplies
(iv) UPS

8. SINGLE PHASE CYCLOCONVERTER

1. What are the disadvantages of step-up cycloconverter?

A It requires forced commutation and output voltage contains harmonics.

2. Why 3-phase to 3-phase cyclo- converter is not popular?

A. It requires 18 SCRs. The firing circuit is complicated.

3. What are the advantages of cyclo- converter?

A. (i) They convert fixed voltage, fixed frequency supply into variable voltage, variable frequency Supply
(ii) Conduction losses are less.

4. What is a cycloconverter?

A It is a circuit which either steps up or steps down the frequency without change in voltage using one stage conversion.

5. What is the function of the cycloconverter circuit?

A. It converts fixed ac voltage at fixed frequency into a variable ac voltage at variable frequency.

6. Mention different types of cycloconverter circuits?

A. (i) single phase to single phase
(ii) single phase to three phase
(iii) three phase to single phase
(iv) three phase to three phase

7. What does a step-up cycloconverter increase?

A. It increases the output frequency.

8. What does a step-up cycloconverter decrease?

A. It decreases the output frequency.

9. How many Thyristors does a center tapped transformer configuration Cycloconverter use?

A. 4

10. How many bridges does a Bridge configuration Cycloconverter use?

A. 3

11. How is the magnitude of the output voltage controlled in a cycloconverter?

A. By varying the firing angle.

12. What are the disadvantages of cycloconverter?

A. (i) The output voltage contains harmonics
(ii) Complex firing circuit

9.MOSFET CHOPPER

20 Mention one advantage of power MOSFET over Power transistor?

A. Power mosfet has very high switching speed compared to power transistor. In power mosfet, no Secondary breakdown occurs as in the case BJT. MOSFET has high input resistance.

2. Distinguish between Depletion and Enhancement MOSFET?

A. In Enhancement type there is increase in current with the increase in voltage. Depletion MOSFET can be used to increase or decrease in drain current with the applied Gate current.

3. In what respect JFET differs from MOSFET?

A. As the name implies in MOSFET there is an oxide layer in between gate and channel

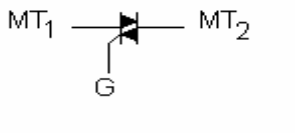
thereby increasing the input impedance of the device.
4. Is the FET a voltage controlled device or current controlled device?
A. Voltage controlled device.
5. What are the disadvantages of FET's?
A. (i) High cost when compared with BJT.
(ii) Low Transconductance
6. What is Pinch-off voltage in FET?
A. It is the minimum Drain to Source voltage at which the Drain current reaches to saturation value.
7. What is IGFET?
A. MOSFET is also called Insulated Gate FET because Gate is insulated from the Source and Drain.
8. Give the classification of MOSFET?
A. (i) Depletion Type and
(ii) Enhancement Type
9. Why the FET possess low noise?
A. Because there is no junctions in FET
10. Is the FET a Unipolar device or Bipolar device?
A. Since the conduction takes place by the movement of only the majority carries, FET is called a Unipolar device.

10.SPEED CONTROL OF SEPERATELY EXCITED DC MOTOR

1. What are the different types of D.C. motor speed control?
A. (i) Armature voltage control
(ii) Field control
2. Which method is suitable for speed control below base speed?
A. Armature voltage control
3. Which method of speed control has faster response?
A. Field control method
4. Name some of the single phase D.C. drive circuits?
A. Chopper controlled D.C. motors
5. Which D.C drive circuit is called a one quadrant drive circuit?
A. Type A chopper
6. Which D.C drive circuit is called a two quadrant drive circuit?
A. Type B Chopper
7. Why is freewheeling diode connected across the load?
A. To suppress the negative part of output voltage.
8. At what firing angle of α will the speed of the motor be maximum?
A. 0°
9.At what firing angle of α will the speed of the motor be minimum?
A. 180°
10. Mention certain applications of Thyristors based D.C. motor speed control?
A. Battery operated vehicles, hoists, elevators etc.

CHARACTERISTICS OF TRIAC:

1. What is the symbol of TRIAC?



2, How many modes of operation of Triac are possible?

A. 4

3. When MT_2 is positive with respect to MT_1, what polarity gate current should be applied for greater gate sensitivity?

A. Positive.

4. When MT_2 is negative with respect to MT_1, what polarity gate current should be applied for greater gate sensitivity?

A. Negative.

5. What are the applications of Triac?

A. Juice makers, Vaccum cleaners for temperature control, illumination control,blenders, etc

6. What are the disadvantages of Triac when compared with SCR regarding Turn-off time?

A. Turn-off time of Triac is longer.

7. What are the maximum ratings of Triac available?

A. 1200V, 300 A

8. Give one advantage of Triac?

A It can be triggered with both positive and negative pulses.

9. Give one disadvantage of Triac?

A. They have lesser voltage and current ratings compared to SCR

10. How many heatsinks are required for a Traic?

A. One heat sink is sufficient for Triac, whereas for equivalent SCR requires Two heat sinks.