

Department of
Electrical Engineering

LAB MANUAL
Power Electronics and Drives LAB

B.Tech– VI Semester



KCT College OF ENGG AND TECH.
VILLAGE FATEHGARH
DISTT.SANGRUR

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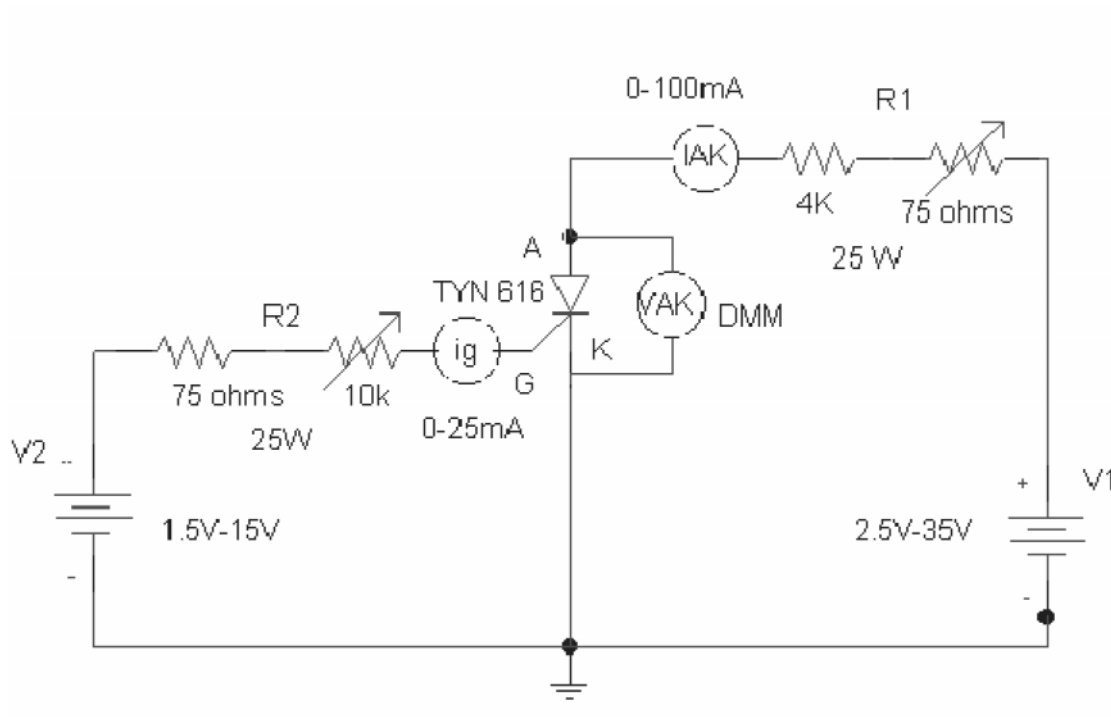
Sr.No:	Experiments
1	To study principle of operation of SCR, plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2	To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator
3	To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load
4	To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
5	To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
6	Study of Jones chopper or any chopper circuit to check the performance
7	Thyristorised speed control of a D.C. Motor.
8	Study of a single-phase cycloconverter.

EXPERIMENT. 1

AIM: To study principle of operation of SCR, plot V-I characteristics and study the effect of gate triggering on turning on of SCR.

APPARATUS REQUIRED: Trainer kit, Patch cards, Multimeters.

CIRCUIT DIAGRAM:



Circuit diagram for VI characteristics of SCR.

SCR Specifications:

$I_{T(rms)}$ - 16 A

$I_{T(rms)}$ - 10 A

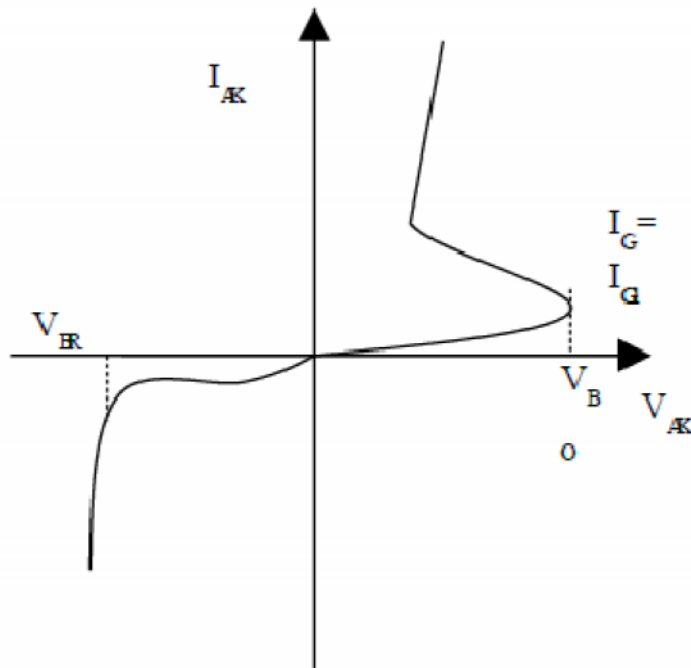
$I_{T(rms)}$ - 160 A

V_{BO} = Forward break over voltage

V_{BR} = Reverse break over voltage

I_g = Gate current

Characteristic curve:



Static characteristic of SCR.

TABULAR COLUMN:

Gate current $I_G = I_{G1} = \dots \text{mA}$

V_{AK} (Volts)	I_A (mA)

PROCEDURE:

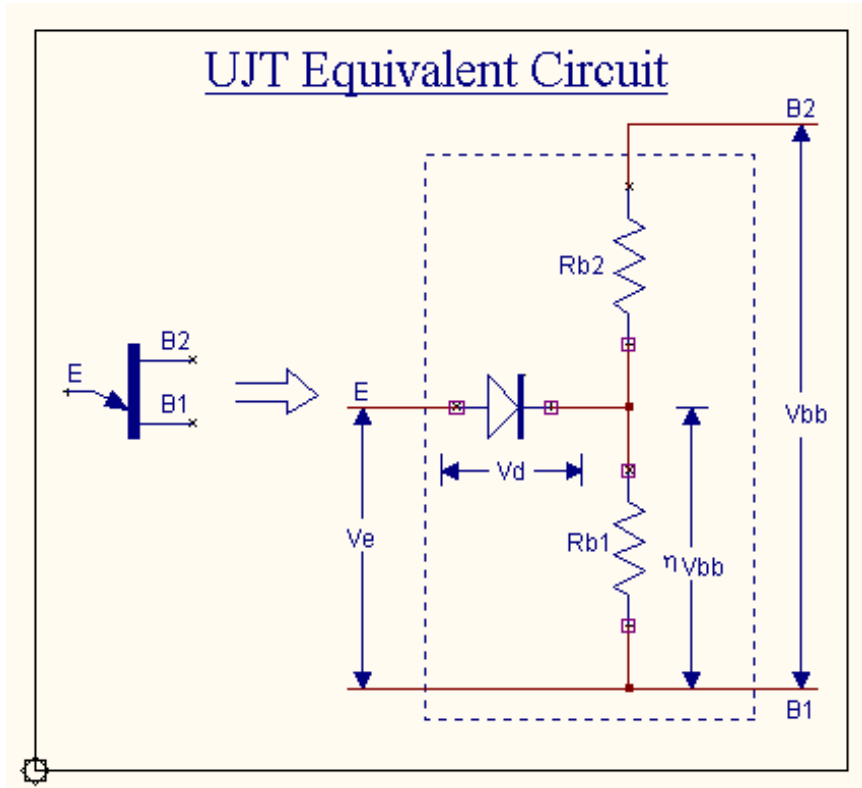
- Connections are made as shown in the circuit diagram.
- Set R_1 and R_2 to mid position and V_1 and V_2 to minimum.
- Set the gate current $I_G = I_{G1}$ (such that forward break over voltage is between 15 to 20 V), by varying R_2 and V_2 .
- Slowly vary V_1 in steps of 2V and note down V_{AK} and I_{AK} at each step till SCR conducts. (Note down maximum V_{AK} , which is forward break over voltage just before SCR conducts).

RESULT: The values of V_{AK} and I_{AK} are noted down, plotted and SCR forward Resistance is found. The values obtained are verified.

EXPERIMENT. 2

AIM To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator

APPARATUS REQUIRED: Trainer kit, Patch cards, Multimeter



PROCEDURE :

Rig up the circuit and connect the triggering circuit as shown in the fig

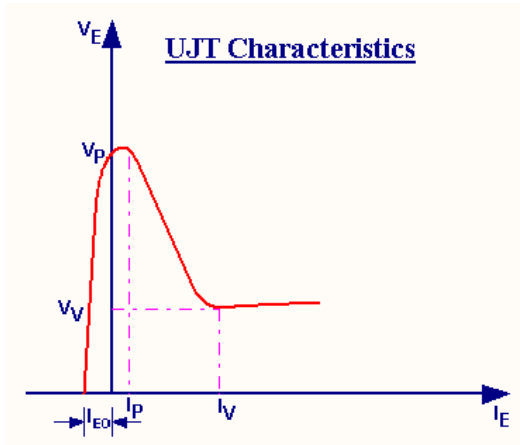
Adjust the triggering angle μ using variable resistance on triggering circuit to observe the waveform on the CRO.

Repeat the experiment for various conditions of the load with different tapping of

V_p

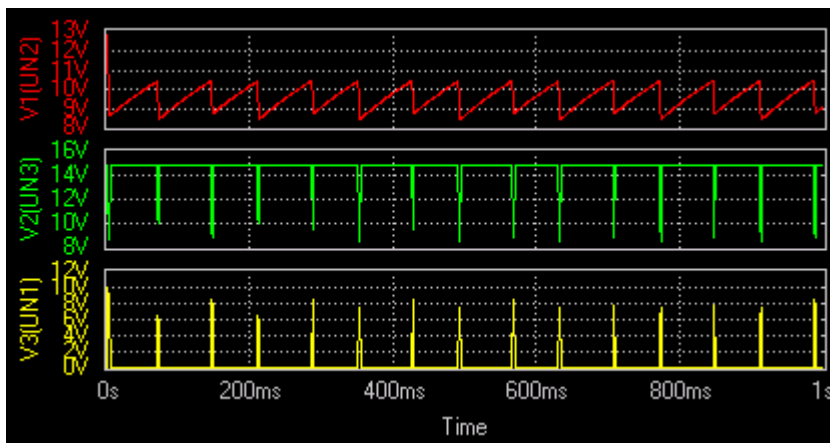
Plot V_E v/s I_E .

EXPECTED WAVE FORMS



Result

The output waveform may be observed in the waveform viewer.



EXPERIMENT NO. 3

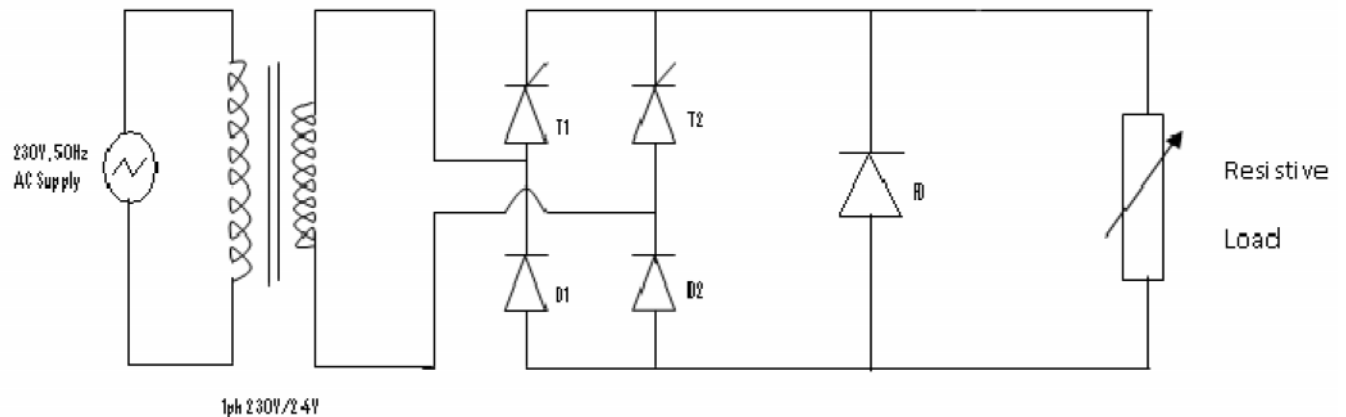
Aim:

To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load

Apparatus required:

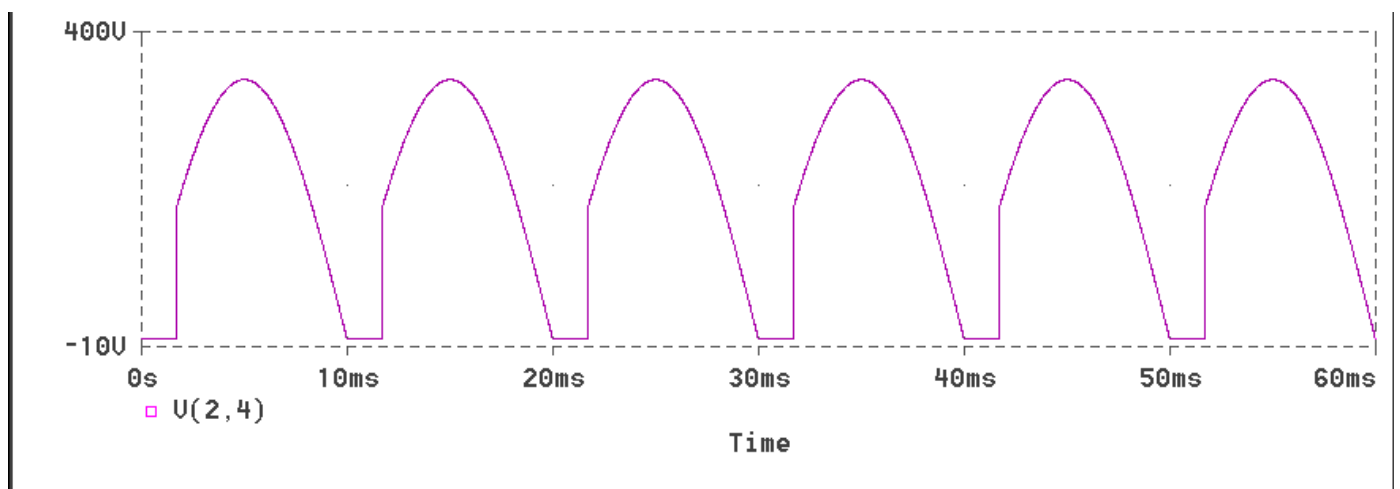
1. Power thyristors
2. Rheostat
3. CRO
4. Transformer (1-phase) 230V/24V
5. Connection wires

Single Phase Half Controlled Bridge Rectifier:



Graph:

The waveform of bridge output voltage



Observation Table:

Serial No.	Triggering angle ' α ' degree	Output voltage V_o (volt) (measured)	Time period(ms)
1			
2			
3			

Procedure:

1. Make the connections as per the circuit diagram.
2. Connect CRO and voltmeter across the load.
3. Keep the potentiometer at the minimum position.
4. Switch on the step down ac source.
5. Check the gate pulses at G1-K1 & G2-K2, respectively.
6. Observe the wave form on CRO and note the triggering angle ' α ' and
7. Note the corresponding reading of the voltmeter. Also note the value of Maximum amplitude V_m from the waveform.
8. Set the potentiometer at different positions and follow the step given in (6) for every position.
9. Tabulate the readings in the observation column.

Result:

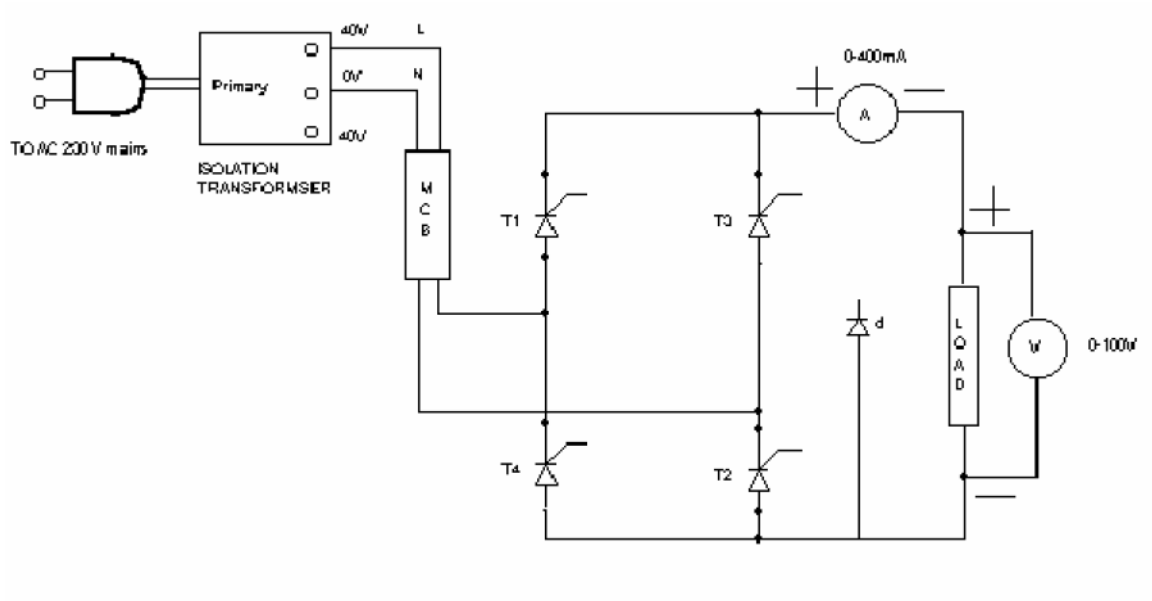
Thus the operation of single phase half controlled converter using R and RL load has studied and the output waveforms has been observed.

EXPERIMENT NO. 4

AIM : . To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.

APPARATUS REQUIRED : Trainer module, Multimeters, CRO ,Patch cords Rheostat, inductor.

CIRCUIT DIAGRAM :

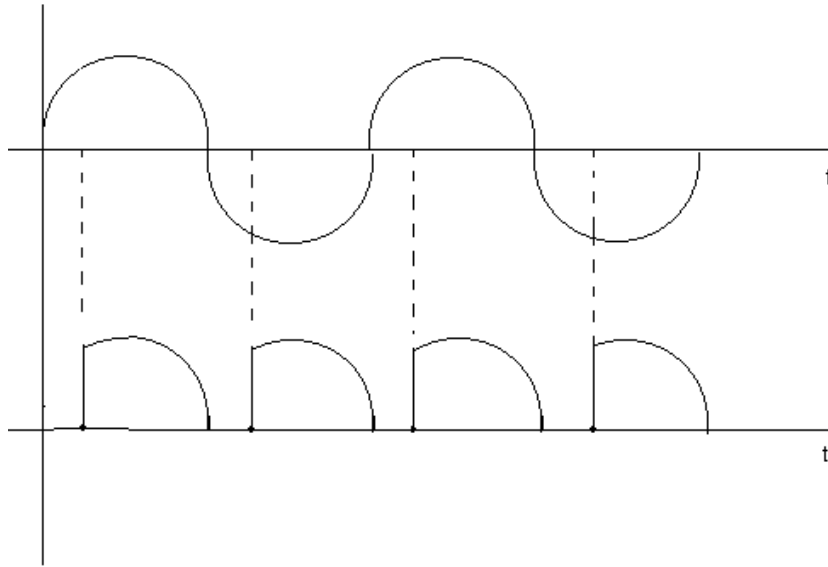


(a) circuit diagram for full controlled, full wave rectifier

PROCEDURE:

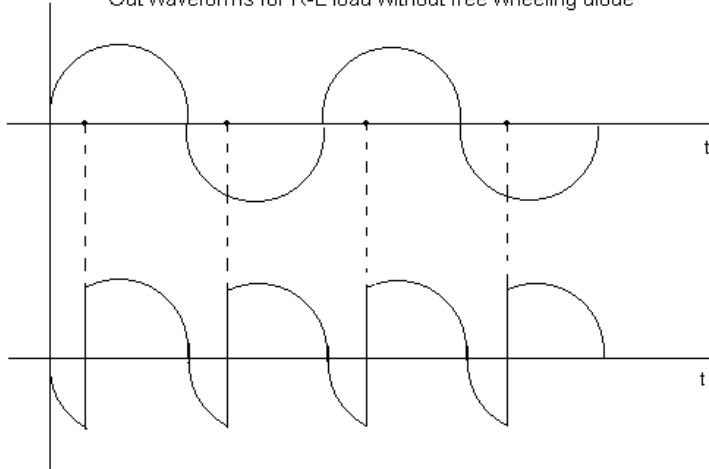
- Rig up the circuit and connect the triggering circuit as shown in the fig
- First connect the circuit for 40V AC tapping as shown in fig
- Adjust the triggering angle μ using variable resistance on triggering circuit to observe the waveform on the CRO.
- Connect 0-300 W rheostats as load resistance.
- Repeat the experiment for various conditions of the load with different tapping of V_p
- AC voltage (max 120V).
- Pure R load.
- R-L load (R load in series with L load).
- R-L loads with freewheeling Diode.
- Plot V_{dc} v/s α , I_{dc} v/s conducting angle.

EXPECTED WAVE FORMS

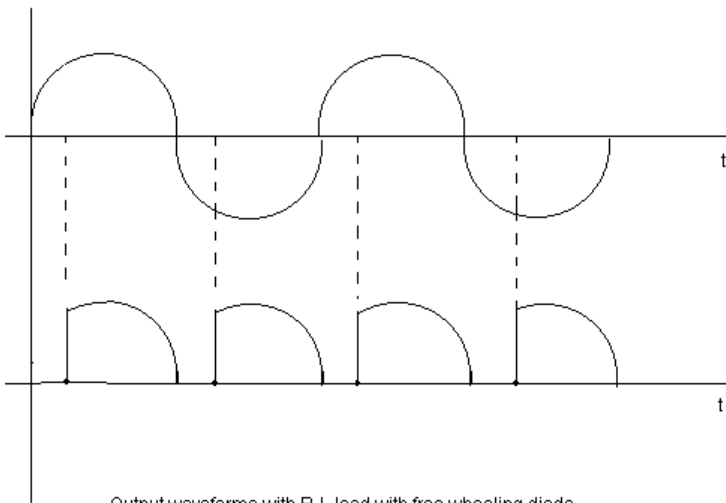


Output waveforms with R-Load

Out waveforms for R-L load without free wheeling diode



Output waveforms with R-L load with free wheeling diode



α

- (b) Output waveforms across R-L load without freewheeling diode.
- (a) Output waveforms across R-L load with freewheeling diode.

TABULAR COLUMN : $A_c V_{in} = 30V (AC), R = 135W$

T (ms)	a_{TH}	Vdc (V)	Idc (A)	a (prac)	Vdc	TH (V)	Idc	TH (A)

--	--	--	--	--	--	--	--	--

R-L load:

R-L LOAD without Dm

R-L LOAD with Dm

α (th)	T A(P)	Vdc	Idc	Vdc	Idc

Calculations:

$$V_{dc} = (V_m/p) * (1 + \cos \alpha)$$

$$I_{dc} = (V_m/p R) * (1 + \cos \alpha)$$

$$(V_m(1 + \cos \alpha)) / p = V_{dc}$$

$$V_m = (V_{dc} * p) / (1 + \cos \alpha)$$

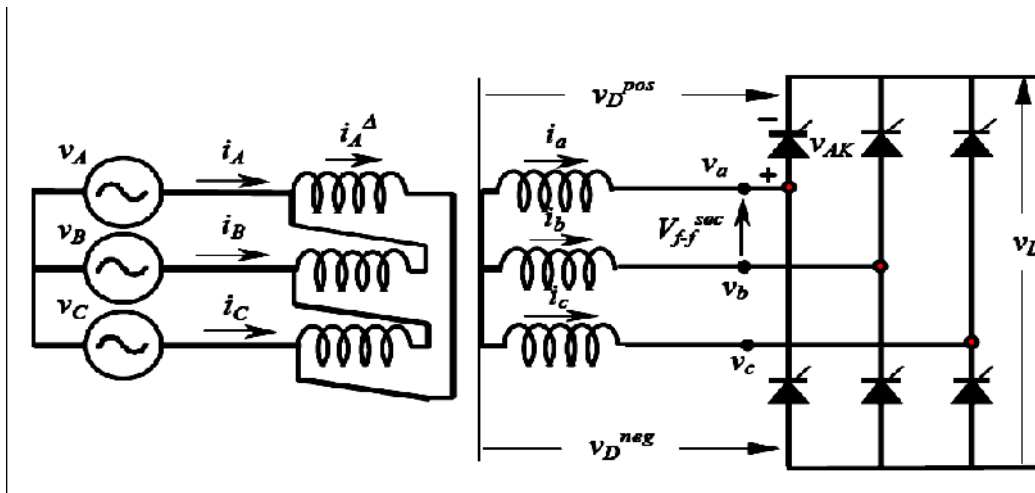
RESULT : The values of Vdc, Idc & as are found out, plotted and verified with expected waveforms.

EXPERIMENT. 5

To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.

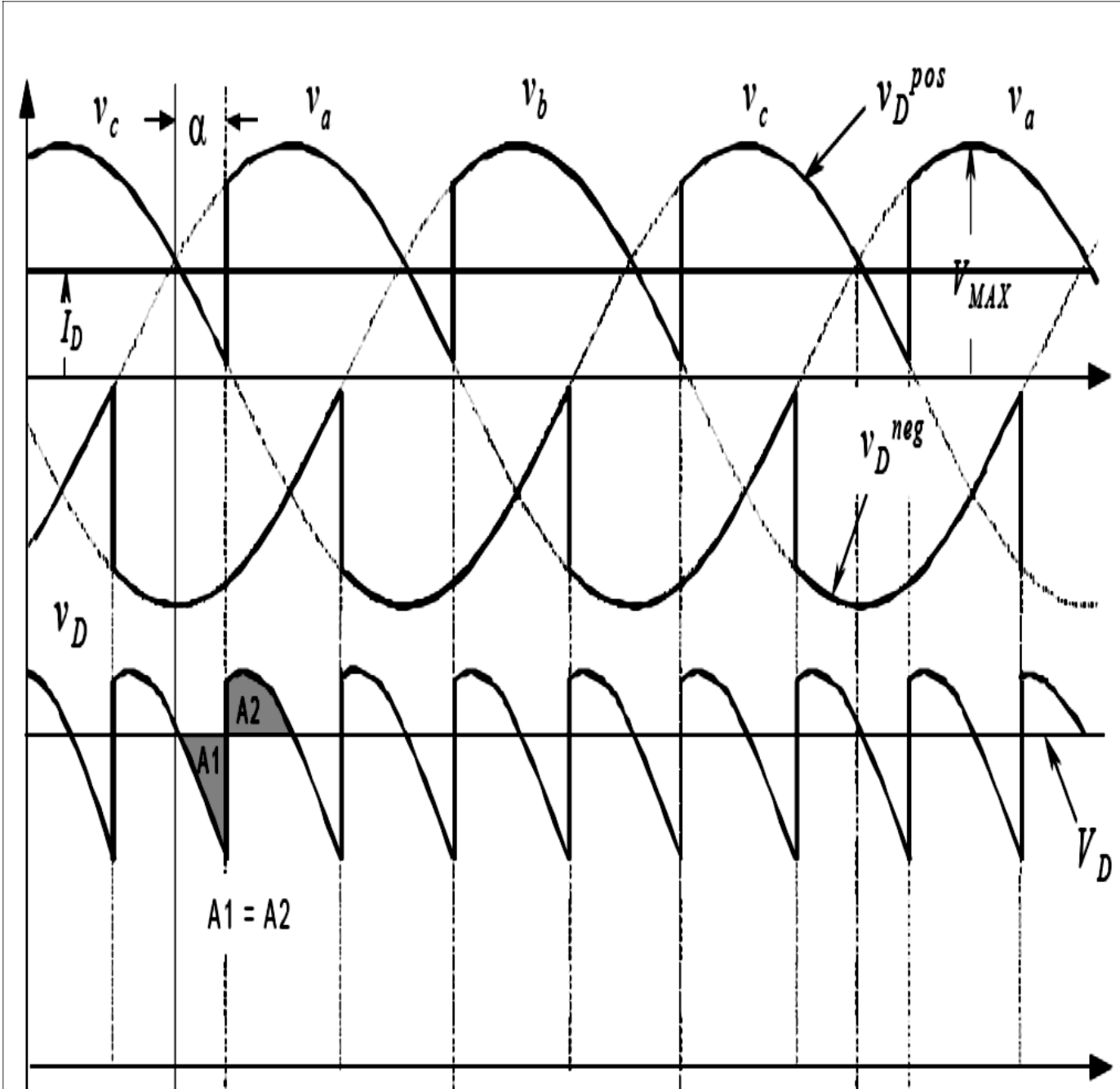
Apparatus

1. Power electronic trainer.
2. Connection wires.
3. Oscilloscope.

Three- phase Full wave controlled rectifier:**Procedure**

1. Connect the three-phase full wave controlled rectifier circuit shown in Fig.(1-a) on the power electronic trainer.
2. Turn on the power
3. By use oscilloscope, plot the input and output waveforms on the same graph paper" same axis".
4. Measure the average and RMS output voltage by connect the AVO meter across load resistance.
5. **Turn off the power**
6. Use an inductive load. With $L=100\text{mH}$ measure the output voltage and plot the output waveform.
7. Repeat step 6 with $L=100\text{mH}$ measure the output voltage and plot the output waveforms.
8. Repeat step 6 & 7 with connect the freewheeling diode across the load.
9. Connect the three-phase bridge half-control rectifier circuit shown in Fig.
10. Repeat steps (2-7).

Output waveform



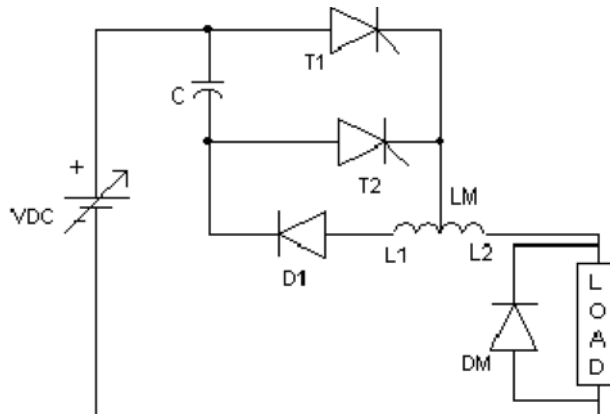
RESULT:
Verify the output waveform

EXPERIMENT. 6

AIM: Study of Jones chopper or any chopper circuit to check the performance

APPARATUS REQUIRED: DC chopper power module-SDCP, Triggering circuit (DC chopper), Load 50 Ω rheostat, DMM.

CIRCUIT DIAGRAM: Jones chopper



Circuit diagram of Jones Chopper

T1, T2 – TYN 616

D1 – BYQ 28200

C – Commutation Capacitor

10m F / 100V

L1- 0 –L2 - Commutation Inductor

500-0-500 m H / 2A.

PROCEDURE :

a) For R – Load:

1. Connections are made as shown in the figure .Use 50 Ω Rheostat for R- Load (Freewheeling diode (DM) is to be connected only for RL load).
2. Adjust VRPS output to 10v and connect to DC chopper module.
3. Switch on DC toggle switch of chopper module.
4. Switch on the trigger input by pushing- in pulsar switch.
5. Observe the output waveform across load on CRO.
6. Keep the duty cycle at mid position and vary the frequency from minimum to maximum and record the output voltage V_{LDC} readings.
7. Keep the frequency at mid position, vary duty cycle from minimum to maximum and output voltage V_{LDC} readings.
8. Note down the output waveform for mid value of frequency and duty cycle.

b) R-L Load:

1. Connections are made as shown in fig .Load is 50 Ω Rheostat in series with inductor $L = 25\text{mH}$ or 50mH .
2. Follow the same procedure as listed in steps 2 to 8 above.
3. Readings and output waveform is to be recorded with and without freewheeling diode.

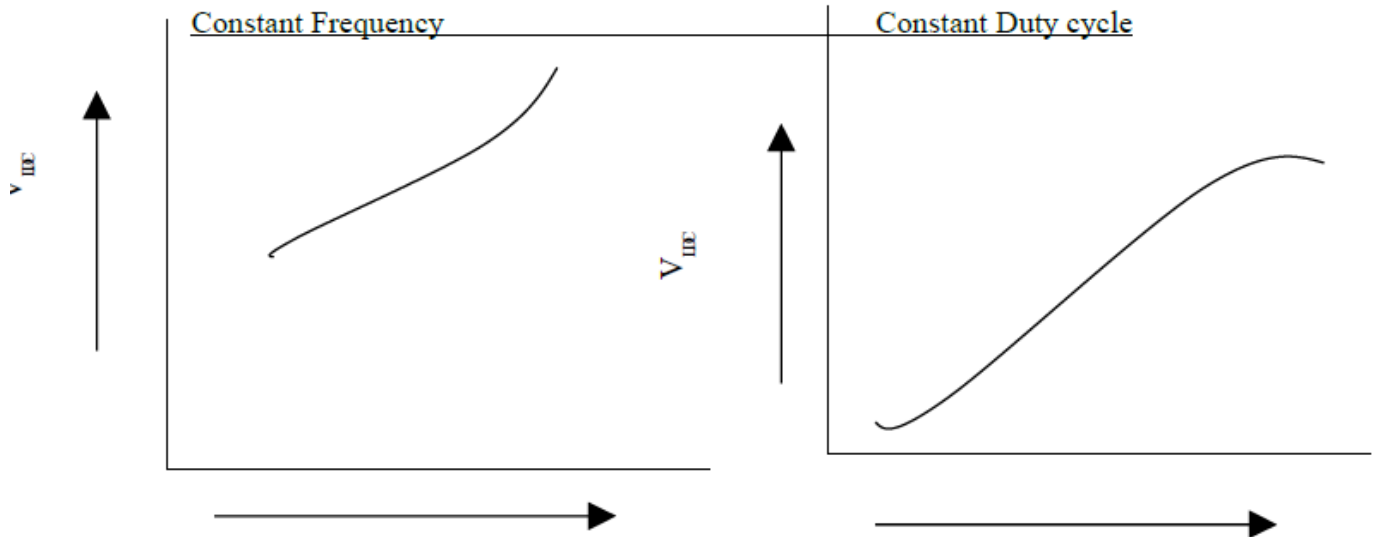
Tabular columns:**Constant Duty cycle****Duty cycle: 50%, $V_{IN} = 10$ to 15V**

Slink	Freq (Hz)	V_o (volts)

Constant Frequency, freq control at mid posit **$V_{IN} = 10V$ to 15V**

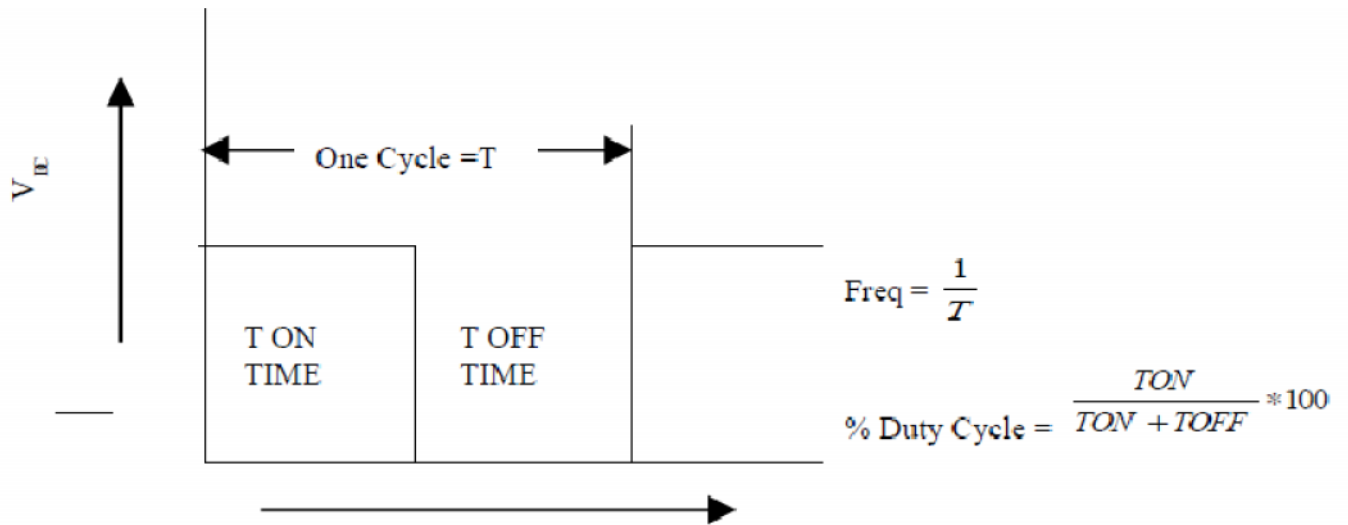
Slink	T_{ON} (sec)	T_{OFF} (sec)	Duty cycle	V_o (volts)

EXPECTED PLOTS:



Showing the plots of Load voltage vs frequency and Load voltage vs. duty cycle.

Expected Waveforms:



RESULT: The waveforms are plotted and verified.

EXPERIMENT. 7

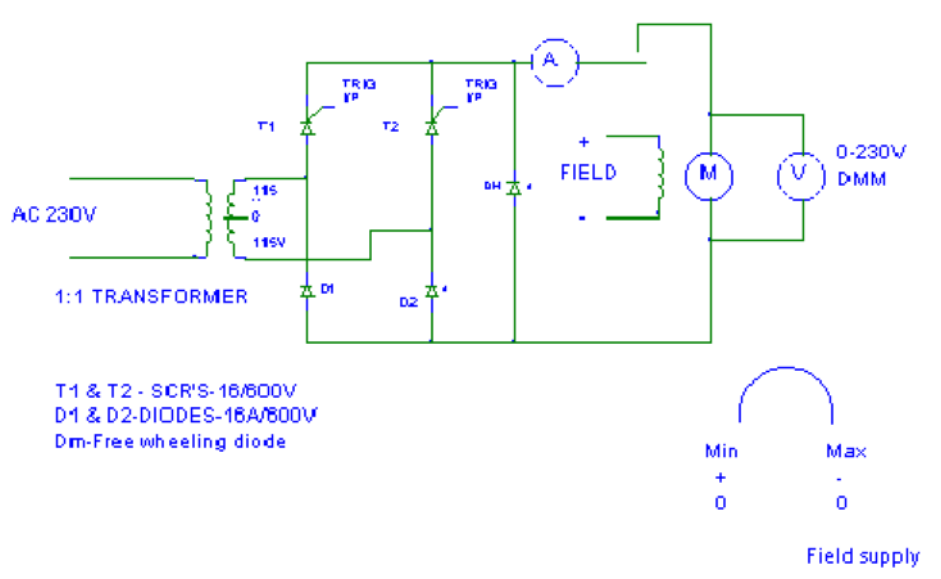
AIM: Thyristorised speed control of a D.C. Motor.

- 1) To control the speed of a separately excited DC motor.
- 2) (i) To plot VDC v/s Speed for Field control.
- (ii) To plot VDC v/s Speed for Armature control.
- (iii) To plot θ_f v/s VDC v/s Speed in Armature control.

COMPONENTS REQUIRED:

DC Motor, Tachometer (Non Contact), Rheostat 50Ω 5A, Speed Control unit, Isolation Transformer,

CIRCUIT DIAGRAM:



Circuit diagram for speed control of a separately excited DC Motor

PROCEDURE:

1. Connect the circuit as shown in fig.
 2. Adjust field supply to mid value.
 3. Vary the firing angle for SCR rectifier and note down the firing angle, Armature voltage, current and speed of the DC motor. Firing angle to be read from the oscilloscope.
 4. Keep the firing angle at mid value (i.e. fix the armature voltage to a constant value).
 5. Vary the field voltage by the pot meter and note down the values of field voltages and speed.
 6. Plot the relevant graph.
- (A) Armature control: θ_f v/s VDC v/s Speed.
(B) Field control: Field voltage (VDC) v/s Speed.

TABULAR COLUMN:

(A) ARMATURE CONTROL

Sl No	Field Voltage (const)	Firing Angle θ_f	VDC volts	IO Amps	Speed

(B) FIELD CONTROL:

Sl No	Armature volt (const)	Field voltage VDC	Speed	Current

RESULT:

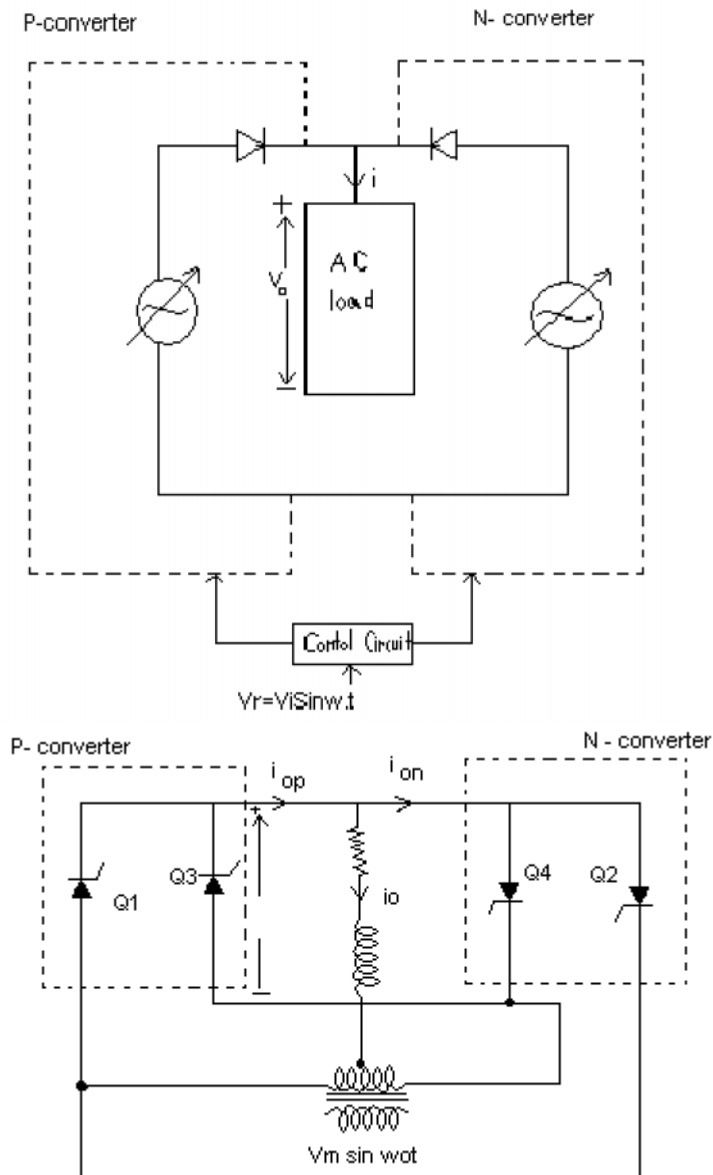
- 1) Speed of a separately excited DC motor is controlled.
- 2) Graph of
 - (i) VDC v/s Speed for Field control.
 - (ii) VDC v/s Speed for Armature control.
 - (iii) θ_f v/s VDC v/s Speed in Armature control.
 is plotted.

EXPERIMENT. 8

AIM: Study of a single-phase cycloconverter.

APPARATUS REQUIRED: AC load , control circuit, CRO, Power Section of Single Phase Cycloconverter

CIRCUIT DIAGRAM

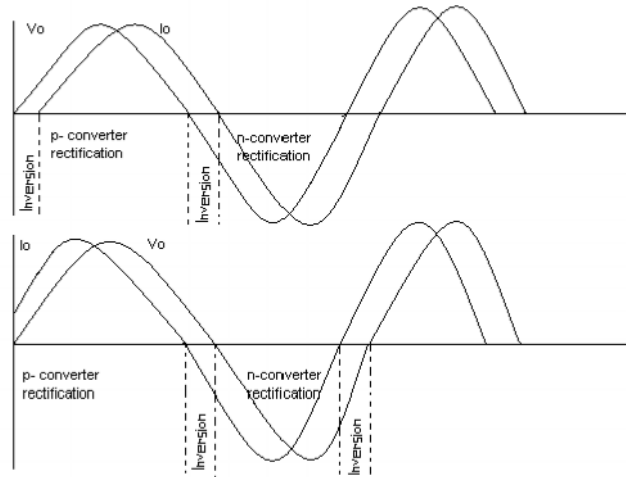


Basic Diagram of Single Phase Cycloconverter

PROCEDURE:

1. Connect the circuit as shown in fig.
2. Adjust the supply at required value.
3. Verify the various output.
4. Observe the waveform on CRO.
5. Plot the relative graph.

Output Voltage and Current Waveforms of the Single Phase Cycloconverter



RESULT:

Verify the output waveform