INSTITUTE OF TEXTILE TECFHNOLOGY

INDUSTRIAL ELECTRONICS LAB MANNUAL

BRANCH- MECHATRONICS ENGG.

5TH SEMESTER

EXPERIMENT – 1(A)

STUDY OF CHARACTERISTICS OF SCR, MOSFET & IGBT

SCR CHARACTERISTICS

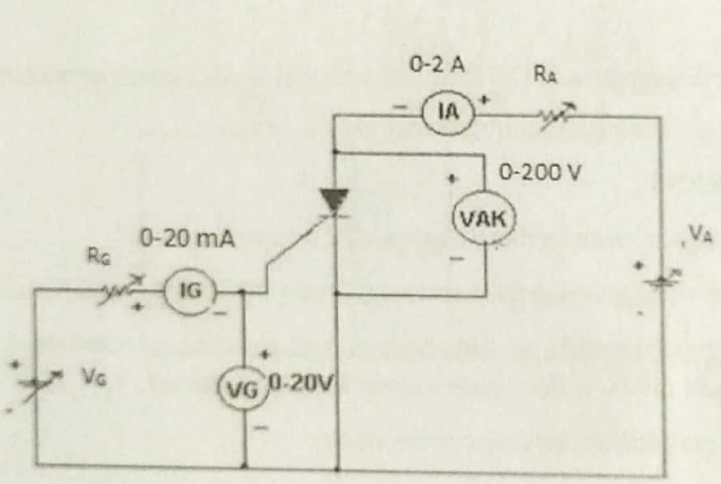
AIM:

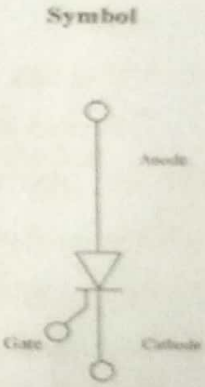
To plot the V - I Characteristics of SCR, MOSFET & IGBT.

APPARATUS:

S. No	Equipment	Range	Type	Quantity
1	SCR characteristics Trainer	-	-	1
2	Patch chords	-	-	
3	DC Voltmeter	-	Digital	1
4	DC Ammeter	-	Digital	1

CIRCUIT DIAGRAM:





Study of Characteristics of SCR

PROCEDURE:

V - I CHARACTERISTICS:

1. Make all connections as per the circuit diagram.
2. Initially keep V_G & V_A at minimum position and R_1 & R_2 maximum position.
3. Adjust Gate current I_g to some constant by varying the V_G or R_G.
4. Now slowly vary $V_A$and observe Anode to Cathode voltage V_{AK} and Anode current I_A.
5. Tabulate the readings of Anode to Cathode voltage V_{AK} and Anode current I_A.
6. Repeat the above procedure for different Gate current I_g.

GATE TRIGGRING AND FINDING V_G AND I_G:-

1. Keep all positions at minimum.

2. Set Anode to Cathode voltage V_{AK} to some volts say 15V.
3. Now slowly vary the V_G voltage till the SCR triggers and note down the reading of gate current(I_G) and Gate Cathode voltage(V_{GK}) and rise of anode current I_A.
4. Repeat the same for different Anode to Cathode voltage and find VAK and I_G values.

TO FIND LATCHING CURRENT:

1. Keep R_2 at middle position.
2. Apply 20V to the Anode to cathode by varying V_2.
3. Rise the Vg voltage by varying V_G till the device turns ON indicated by sudden rise in I_A. At what current SCR trigger it is the minimum gate current required to turn ON the SCR.
4. Now set R_A at maximum position, then SCR turns OFF, if it is not turned off reduce V_A up to turn off the device and put the gate voltage.
5. Now decrease the R_A slowly, to increase the Anode current gradually in steps.
6. At each and every step, put OFF and ON the gate voltage switches V_G. If the Anode current is greater than the latching current of the device, the device says ON even after switch OFF S1, otherwise device goes to blocking mode as soon as the gate switch is put OFF.
7. If $I_A > I_L$ then, the device remains in ON state and note that anode current as latching current.
8. Take small steps to get accurate latching current value.

TO FIND HOLDING CURRENT:

1. Now increase load current from latching current level by varying R_A & V_A.
2. Switch OFF the gate voltage switch S1 permanently (now the device is in ON state).
3. Now increase load resistance(R2), so that anode current reducing, at some anode current the device goes to turn off .Note that anode current as holding current.
4. Take small steps to get accurate holding current value.
5. Observe that $I_H < I_L$.

TABULAR COLUMN:

S. No	I_G= Amps	
	V_{AK} (Volts)	I_A (Amps)
1		
2		
3		
4		
5		

S. No	I_G= Amps	
	V_{AK} (Volts)	I_A (Amps)
1		
2		
3		
4		
5		

EXPERIMENT – 1(B)

MOSFET CHARACTERISTICS

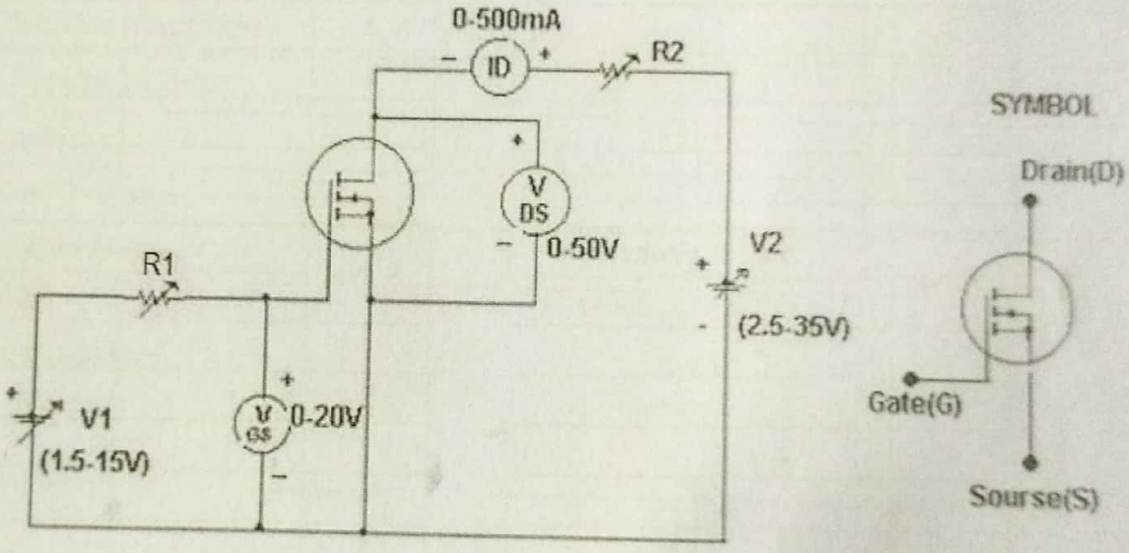
AIM:

To study the output and transfer characteristics of MOSFET

APPARATUS:

S. No	Equipment	Range	Type	Quantity
1	MOSFET characteristics Trainer			
2	Patch chords			
3	DC Voltmeter			
4	DC Ammeter			

CIRCUIT DIAGRAM:



Study of Characteristics of MOSFET

PROCEDURE:

TRANSFER CHARACTERISTICS:

1. Make all connections as per the circuit diagram.
2. Initially keep V_1 & V_2 at minimum position and R_1 & R_2 middle position.
3. Set V_{DS} to some say 10V.
4. Slowly vary Gate source voltage V_{GS} by varying V1.
5. Note down I_D and V_{GS} readings for each step.
6. Repeat above procedure for 20V & 30V of V_{DS}. Draw Graph between I_D & V_{GS}.

OUTPUT CHARACTERISTICS:

1. Initially set V_{GS} to some value say 3V by varying V1.
2. Slowly vary V2 and note down I_D and V_{DS}.
3. At particular value of V_{GS} there a pinch off voltage between drain and source. If $V_{DS} < V_P$ device works in the constant resistance region and I_O is directly proportional to V_{DS}. If $V_{DS} > V_P$ device works in the constant current region.
4. Repeat above procedure for different values of V_{GS} and draw graph between I_D *VS* V_{DS}.

TABULAR COLUMN:

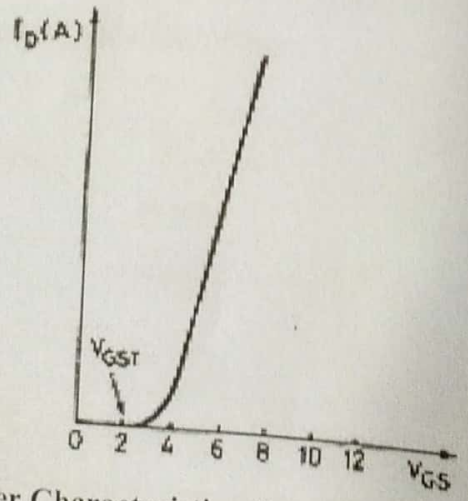
S. No.	V_{GS} = VOLTS	
	V_{DS} (Volts)	I_D (Amps)
1		
2		
3		
4		
5		

S. No	V_{GS} = VOLTS	
	V_{DS} (Volts)	I_D (Amps)
1		
2		
3		
4		
5		

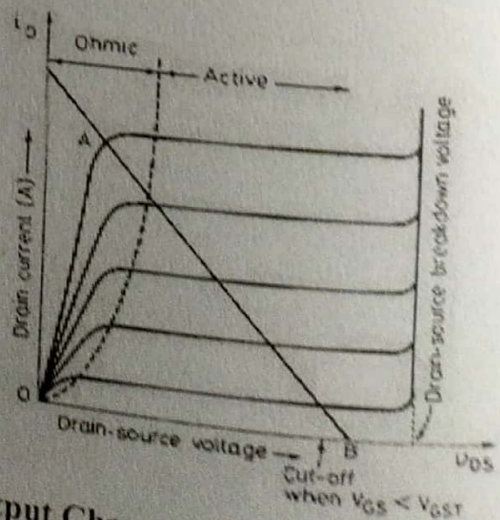
S. No	V_{DS}= (Volts)	
	V_{GS} (V)	I_D(A)
1		
2		
3		
4		
5		

S. No	V_{DS} = (Volts)	
	V_{GS} (V)	I_D(A)
1		
2		
3		
4		
5		

MODEL GRAPH:



Transfer Characteristic of MOSFET



Output Characteristics of MOSFET

EXPERIMENT – 3

SINGLE PHASE FULLY CONTROLLED BRIDGE CONVERTER WITH R AND RL LOADS

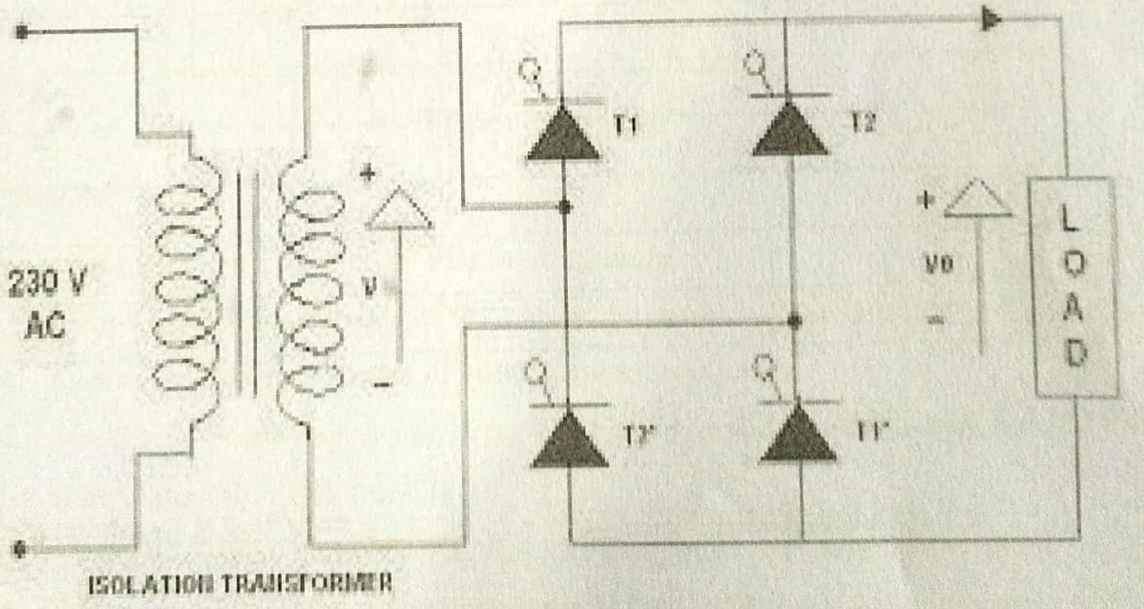
AIM:

To study the single phase fully controlled bridge converter with R & RL Load.

APPARATUS:

S. No	Equipment	Range	Type	Quantity
1	Single phase full controlled bridge converter power circuit and firing circuit			
2	CRO with deferential MODEL			
3	Patch chords and probes			
4	Isolation Transformer			
5	Variable Rheostat			
6	Inductor			
7	DC Voltmeter			
8	DC Ammeter			

CIRCUIT DIAGRAM:



Single Phase Fully Controlled Bridge Converter

PROCEDURE:

1. Make all connections as per the circuit diagram.
2. Connect firstly 30V AC supply from Isolation Transformer to circuit.
3. Connect firing pulses from firing circuit to Thyristors as indication in circuit.
4. Connect resistive load 200Ω / 5A to load terminals and switch ON the MCB and IRS switch and trigger output ON switch.
5. Connect CRO probes and observe waveforms in CRO across load and device in single phase fully controlled bridge converter.
6. By varying firing angle gradually up to 180° and observe related waveforms.
7. Measure output voltage and current by connecting AC voltmeter & Ammeter.
8. Tabulate all readings for various firing angles.
9. For RL Load connect a large inductance load in series with Resistance and observe all waveforms and readings as same as above.
10. Observe the various waveforms at different points in circuit by varying the Resistive Load and Inductive Load.
11. Calculate the output voltage and current by theoretically and compare with it practically obtained values.

TABULAR COLUMN:

S. No	Input Voltage (V_{in})	Firing angle in Degrees	Output voltage (V_o)		Output Current (I_o)	
			Theoretical	Practical	Theoretical	Practical
1						
2						
3						
4						
5						
6						

MODEL CALCULATIONS:

For R-L Load:

V_o = $(2\sqrt{2}V/\pi) * \cos\alpha$

I_o = $(2\sqrt{2}V/\pi R) * \cos\alpha$

α = Firing Angle

V = RMS Value across transformer output

For R Load:

$V_o = (\sqrt{2}V/\pi) * (1+\cos\alpha)$

$I_o = (\sqrt{2}V/\pi R) * (1+\cos\alpha)$

EXPERIMENT – 04

GATE FIRING CIRCUITS FOR SCRS

(R - C TRIGGERING)

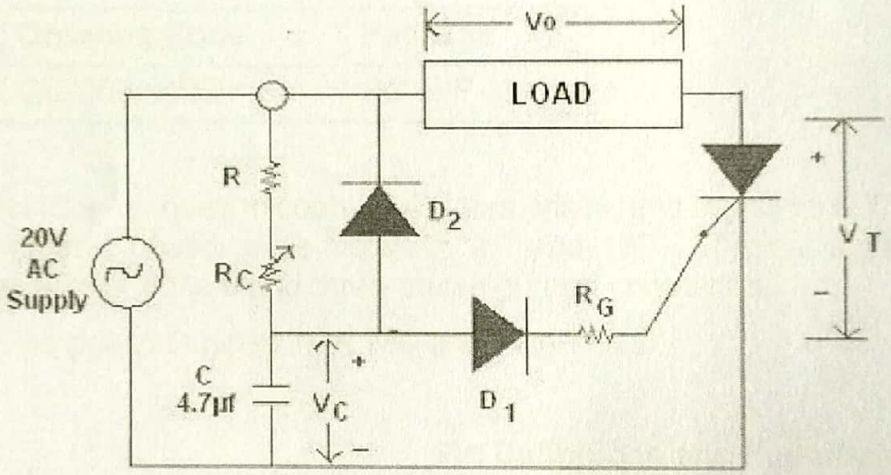
AIM:

To study the Resistance - capacitance (RC) Triggering circuit of SCR.

APPARATUS:

S. No	Name of the Equipment	Range	Qty
1	Resistance-Capacitance Firing Circuit		
2	Patch chords		
3	CRO with differential MODEL		
4	R-Load		

CIRCUIT DIAGRAM:

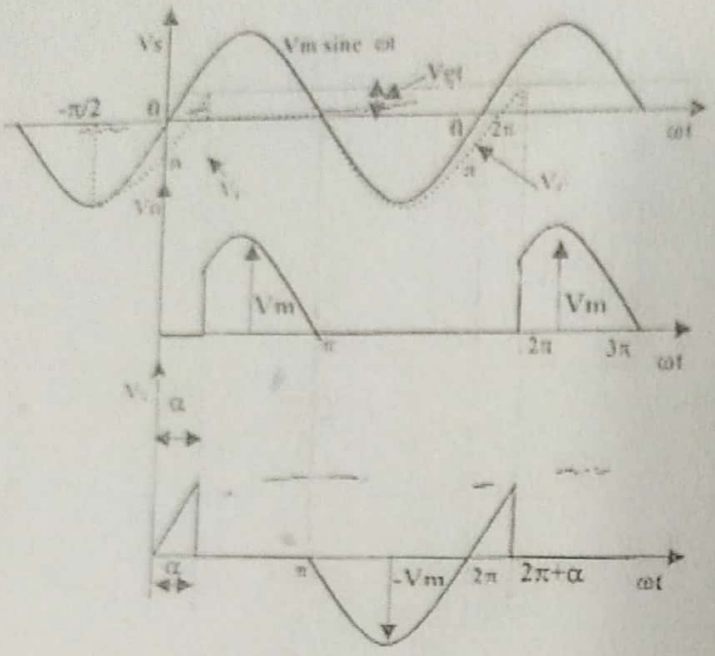


RC Triggering Circuit

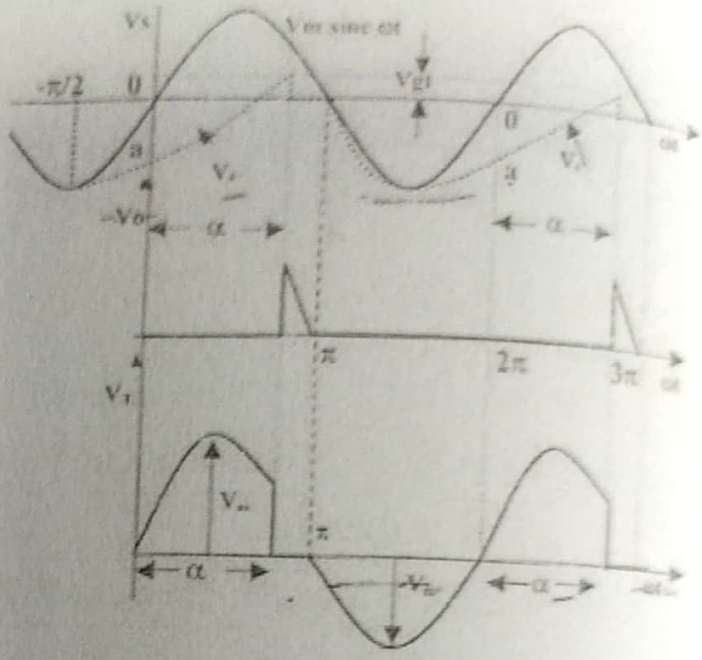
PROCEDURE:

1. Make all connections as per the circuit diagram.
2. Give the AC Power supply 20V/1A from the source indicated in the front panel.
3. Connect Load i.e., Rheostat of 200Ω between two points.
4. Switch ON Power supply and observe the wave forms of input & output at a time in the CRO.[CH-1 or CH-2].
5. Slowly vary the control Resistor R_C, that firing angle can vary from 0-180°.
6. Observe various voltage waveforms across load, SCR and other points, by varying the Load Resistance and Firing R_C part.
7. Compare practical obtained voltage waveform with theoretical waveform and observe the Firing angle in R - C Triggering.

MODEL GRAPH:

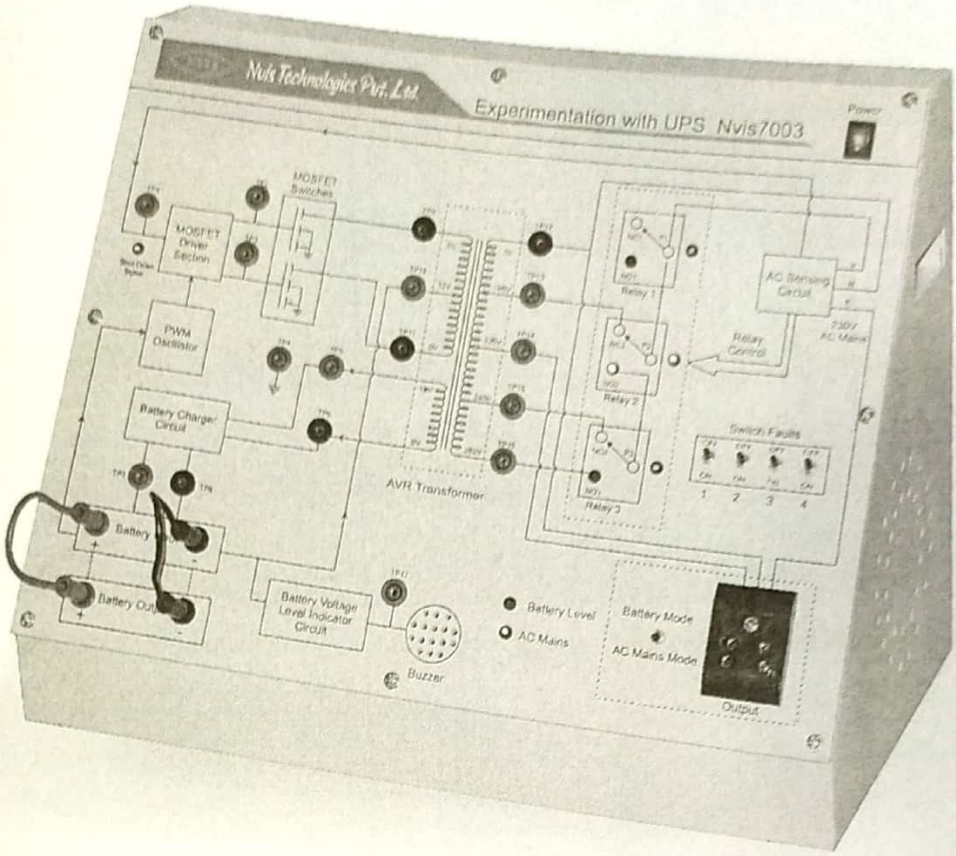


For Small Value of R



For Large Value of R

Output Wave forms of RC Triggering



vis 7003 Experimentation with UPS is a very versatile training system, has been designed to explain a very teresting and frequently used switching based power supply-The UPS (Uninterrupted Power Supply).

/hen electrical utility power fails or drops to an unacceptable level, UPS are key in saving and protecting valuable)mputer data. UPS equipment provides power conditioning, power regulation and, in case of power outages, rovides the crucial backup power needed for an orderly shutdown of computer processes and files. UPS are also sed for emergency power supplies for Hospitals, data centers, municipalities, industrial and commercial centers) supply power in case of power failure from main supply authority.

eatures

- In depth explanation of PWM switching technology, which is one of the most important feature of UPS
- A Low cost product demonstrating all basic concept of UPS
- Various test point are provided so that one can easily measure the voltages of different sections
- Designed considering all safety standards
- Online product tutorial

Scope of Learning

- Study of PWM Technology
- To understand the overall functioning of UPS Trainer
- Study of AVR transformer section of UPS
- To study the UPS circuit in load condition
- To identify different faults and to study the systematic procedure of their troubleshooting in UPS circuit

Technical Specifications

Input Voltage	:	190 to 260V AC ±10%, 50Hz (Single Phase)
Output Voltage	:	230V AC, ±10%
Transformer		
Input	:	12-0-12V AC
Outputs	:	0, 190, 220, 240, 260V AC 18 - 0V AC for battery charging
Battery		
Rating	:	12V DC / 7.5 AH
Type	:	SMF Rechargeable Battery
Technology	:	MOSFET-PWM
Output Power Capacity	:	500VA
Dimensions (mm)	:	W 365 x D 260 x H 120
Weight	:	5kg (approximate)

Optional

Oscilloscope 'Caddo 801'

Multimeter 'Caddo 50/51'