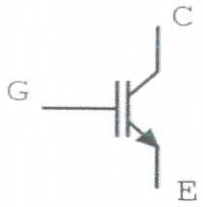
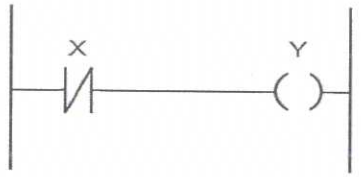
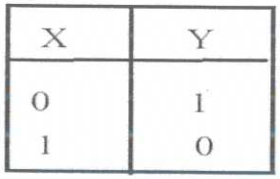
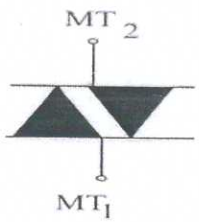
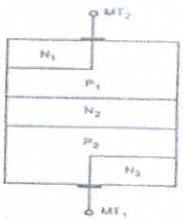
58 9/11/23

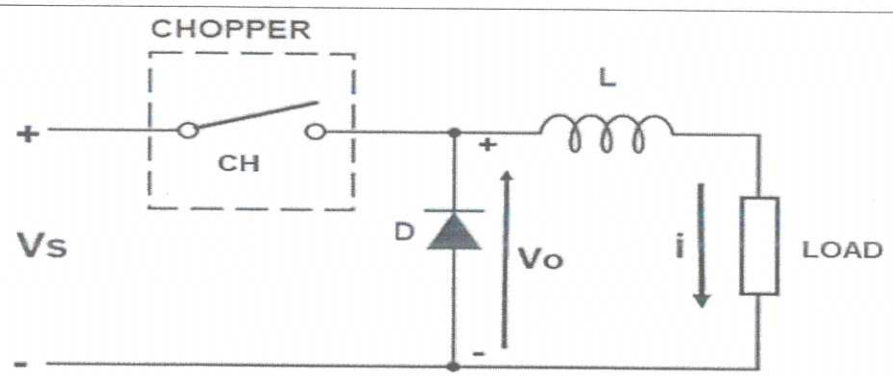
12 Nov-23

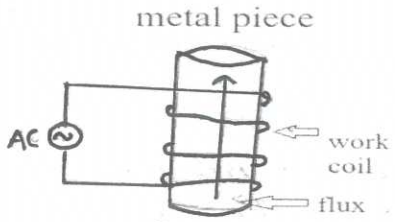
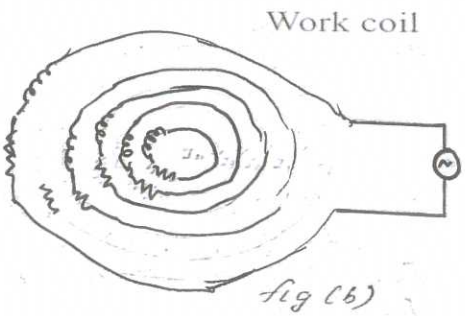
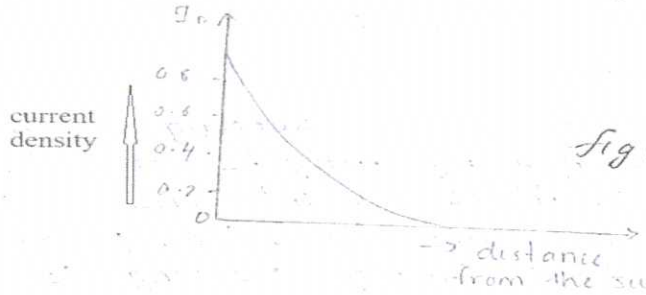
Scoring Indicators

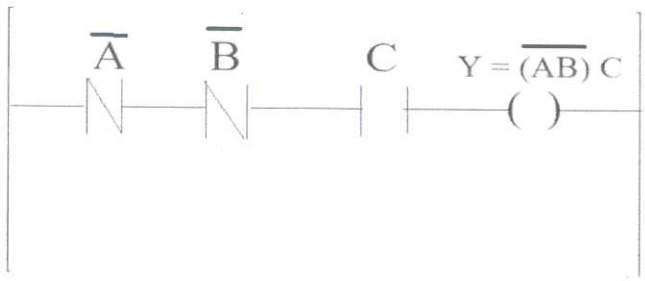
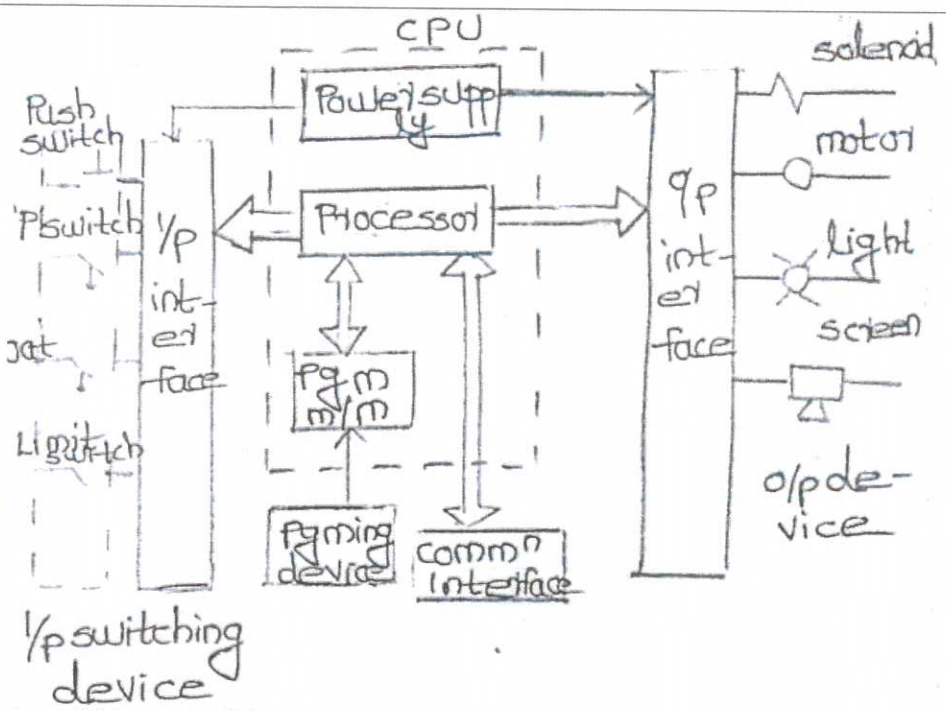
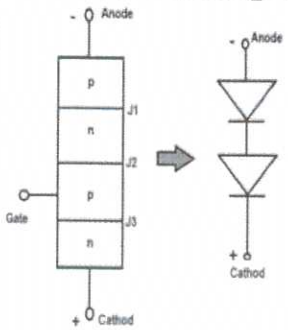
COURSE NAME : INDUSTRIAL AUTOMATION
COURSE CODE : 5042

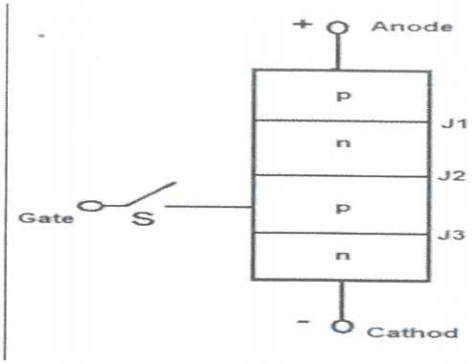
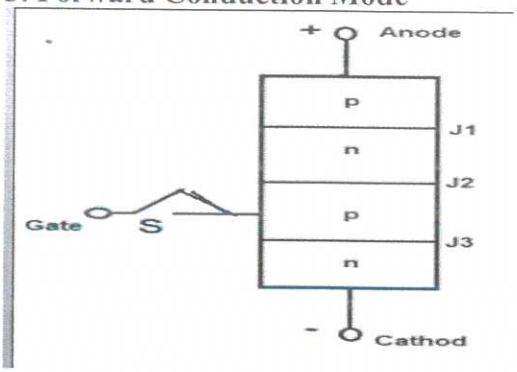
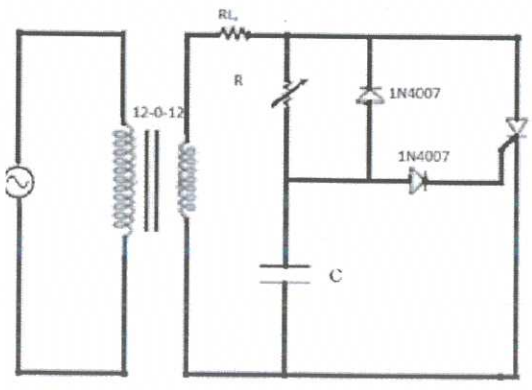
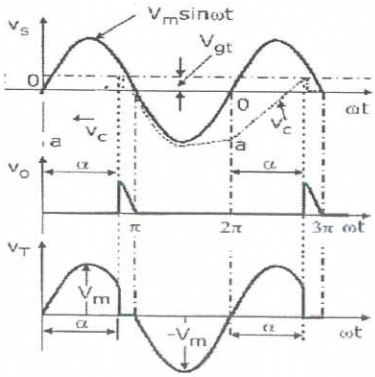
QID: **2109230089**

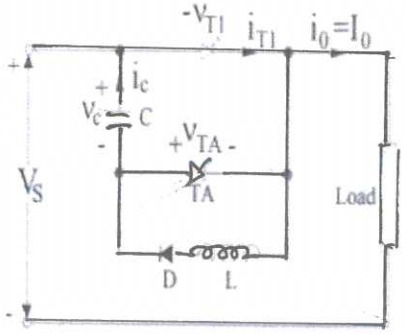
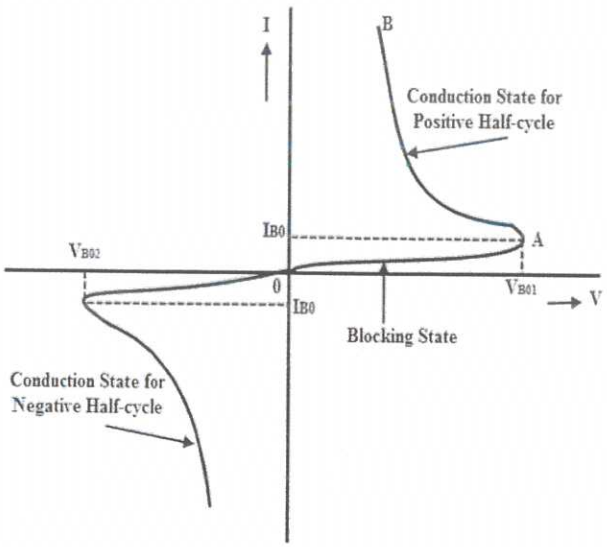
Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			9
I.1		1	1	
I.2	The process of switching SCR from ON state to OFF state is called commutation	1	1	
I.3	$f_0 < f_s$	1	1	
I.4	Firing angle	1	1	
I.5	Dielectric heating, Induction heating	1	1	
I.6	A device that provides battery backup when the electrical power fails or drops to an unacceptable voltage level.	1	1	
I.7	Resistance welding.	1	1	
I.8	 	1	1	
I.9	AND	1	1	
	PART B			24
II.1	 Symbol  Structure	1.5 1.5	3	
II.2	Turn on methods of SCR are Forward Voltage Triggering Temperature Triggering dv/dt Triggering Radiation Triggering Gate Triggering	3	3	
II.3	**Dual Converter** — A power electronic circuit which can **Inverter** — A power electronic circuit which	Any 3	3	

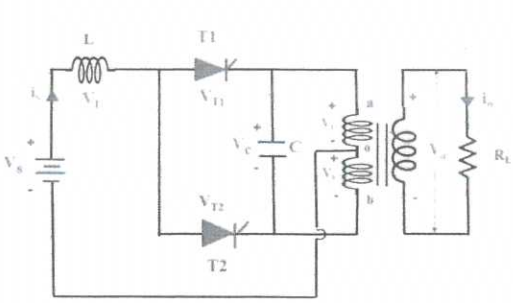
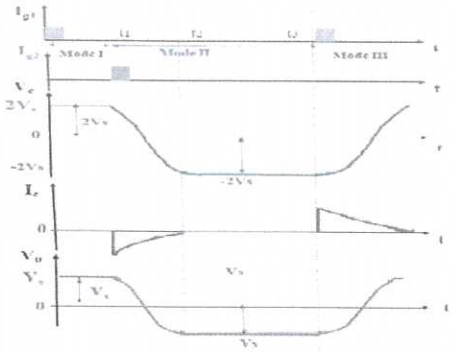
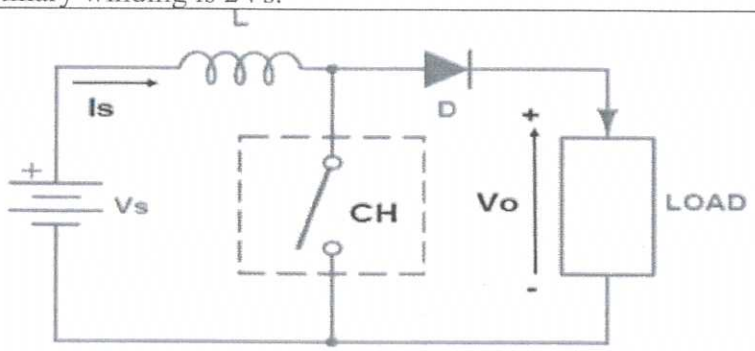
	transform the AC to DC and DC to AC at the same time, is known as dual converters. The input power to the converter is AC One will perform as a rectifier and the other will perform as inverter, double process wili coour at a moment. Dual Converters are used in Direction and speed control of DC motor,Applicable wherever the reversible DC is required, Industrial variable speed DC drives etc.	can transform DC into AC is known as inverter. The input of an inverter is DC power only. The output of an inverter is AC power only. Inverters are used in Induction heater,Sonar transmitter, Fluorescent lighting, Ultrasonic generator etc.			
II.4	 Fig. - (i)		3	3	
II.5	1. Stator voltage control 2. Chopper controlled resistance in the rotor citcuit 3. Variable voltage variable frequency control		1 1 1	3	
II.6	It is the process of fusing together two or more pieces of metal by passing high values of AC or DC for a short duration through the areas of contact. There are 5 types of resistance welding 1. Spot welding, 2. seam welding, 3. Butt welding, 4. Projection welding and 5. Pulsation welding		3	3	

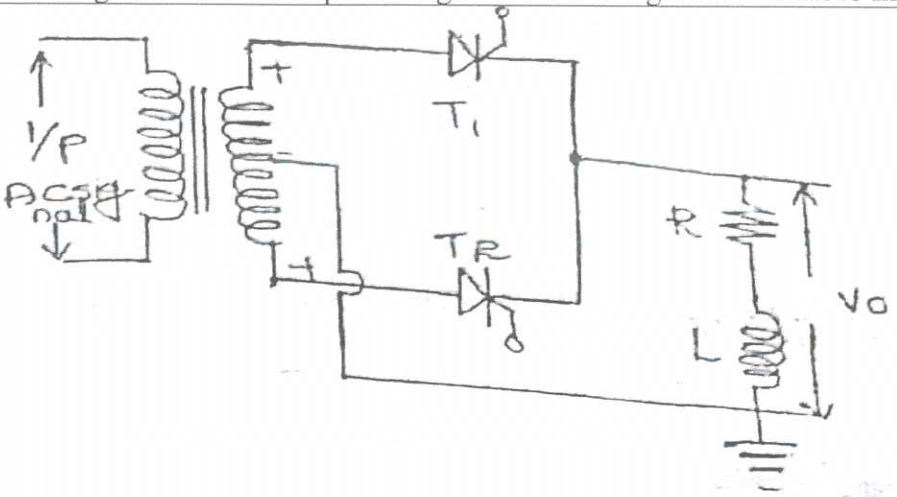
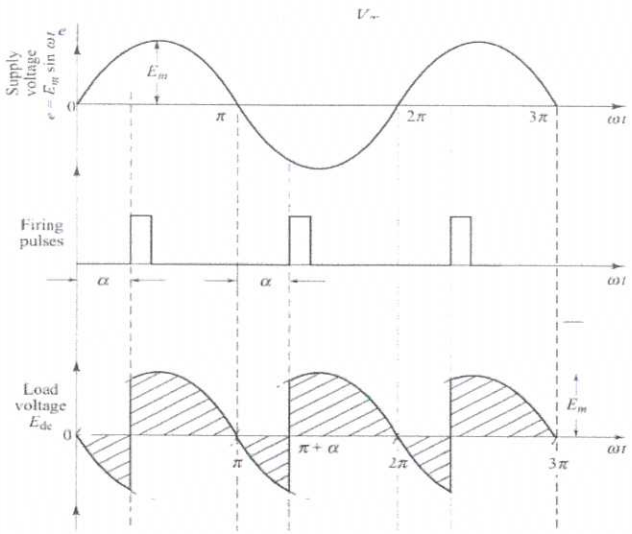
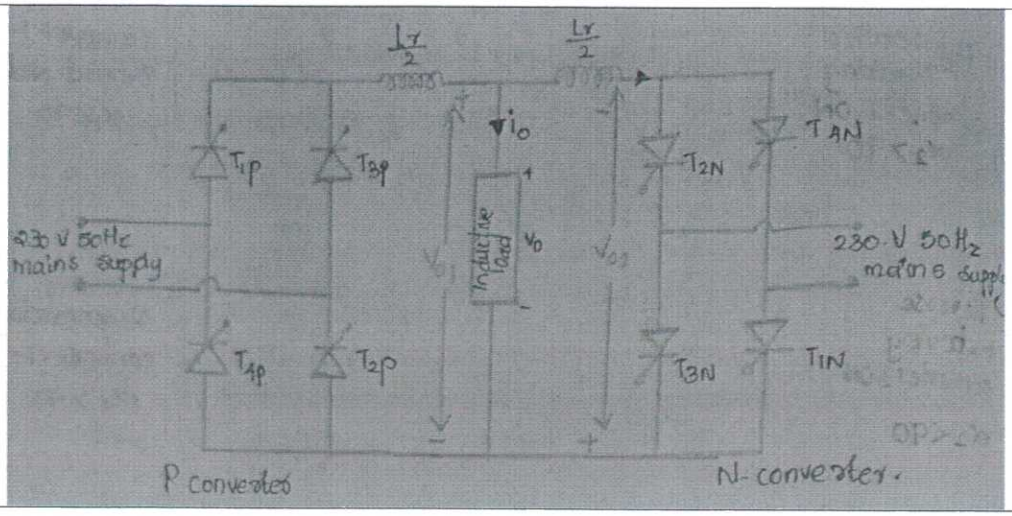
II.7	 fig (a)  fig (b)  fig (c) In every transformer there is an undesirable eddy current loss. The same eddy current loss may be effectively utilised for heating a metal piece. This process is called induction heating. fig(a) shows the basic setup for induction heating. An Ac magnetic field produced by the current I. in the work coil passes through the metal object. When the voltage induced in the metal object is given by	1.5 1.5	3	
II.8	1. Petro Chemical Industry- mainly used in fractional distillation unit for Crude oil separation. 2. Steel Industry – used in blast furnaces, high temperature monitoring systems. 3. Power generation – used for boiler control from water injection, temperature, fuel monitoring etc. 4. Process Industries – Used to control Air flow. 5. Chemical Industry – used to control mixing of chemicals, temperature monitoring etc in chemicals plants in suitable proportions.	6x.0.5	3	

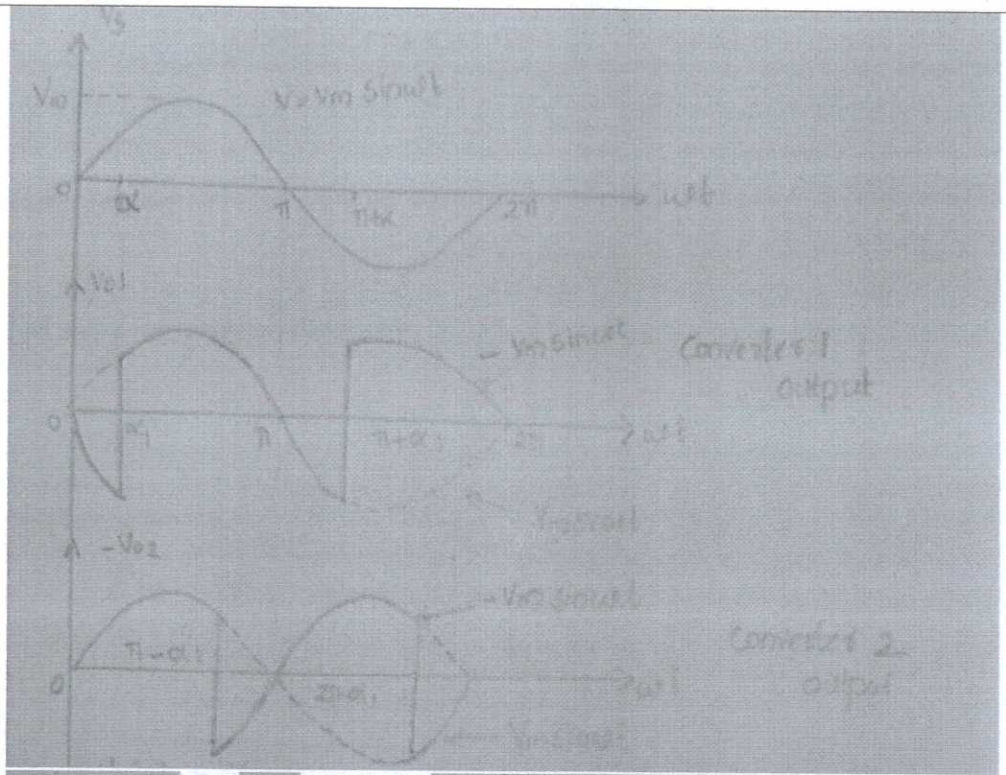
	6. Used in nuclear power generation plants 7. Used in Home automation including home security and device controls. 8. Used in Agriculture field for controlling water flow, weather monitoring, in Plant growth chambers where the temperature, humidity, rain, due etc are controlled in a planned manner for reproducing hybrid plants and seeds.			
II.9		3	3	
II.10		Fig:3	3	
	PART C			42
III.	SCR has three basic mode of operation: ***Reverse Blocking Mode***, ***Forward Blocking Mode*** and ***Forward Conduction Mode*** 1. Reverse Blocking Mode 	List:1 3x2	7	

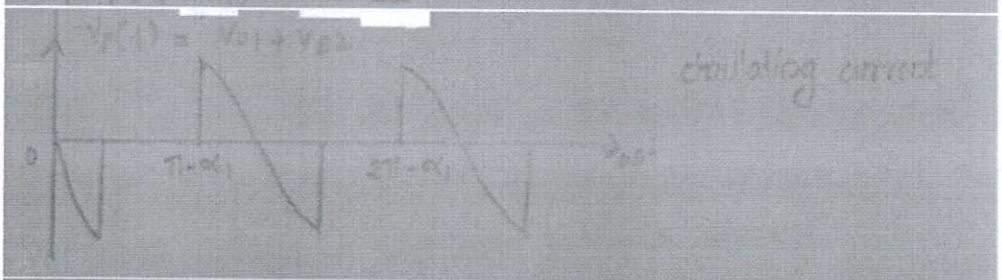
	the anode to cathode voltage in is negative in this mode. anode terminal is made negative with respect to cathode, This leads to reverse biasing of the SCR. Consequently, junction J1 and J3 are reversed biased while the junction J2 is forward biased. The device behaves as if two diodes are connected in series with reverse voltage applies across them. SCR offers high impedance in the reverse direction and hence do not conduct. This is the reason, in reverse blocking mode; an SCR may be treated as an open switch. **2. Forward Blocking Mode**  In this mode, the junction J1 and J3 are forward biased but junction J2 is reverse biased. A small leakage current, called the ***forward leakage current*** **3. Forward Conduction Mode**  In this mode, the junction J1 and J3 are forward biased but junction J2 is reverse biased. Apply positive gate pulse between gate and cathode terminal	:		
IV	  When the supply voltage is negative **capacitor** charges to maximum −ve = Vm at ωt = 90° with lower plate is positive and upper plate is negative.When	Expn2 Ckt:3 Wave Form 2	7	

	the capacitor charges to the positive voltage equal to the gate trigger voltage SCR turn on. and voltage across capacitor falls to very lower value SCR conduct till the end of positive half cycle and negative half cycle again the process repeats by RC is given by $RC \geq 4 / \omega$.Where, $\omega = 2\pi / t$ and $t = 1 / f$. Here firing angle can be controlled from (0 – 180°).			
V	• Class-D Commutation is a commutation method used to turn off thyristor in a DC circuit by the application of a sudden reverse voltage across the terminals of SCR. This is the reason, it is also called Impulse Commutation. • A Class-D commutation circuit consists of Main Thyristor T1, Auxiliary Thyristor TA, Capacitor C, Diode D and Inductor L. Load current I0 is assumed to be constant.  	Expn3 Ckt:4	7	
VI	 The figure above shows the V-I characteristics of DIAC which indicates the current flow through the diac with respect to the voltage across it. As long as the voltage across it is within its breakover limits that is from –VBO to +VBO, the resistance offered by the diac is very high. So, a small leakage current flows through the device for applying positive voltage which is less than +VBO and negative voltage less than –VBO as shown in figure. The region OA in the portion of the characteristics is the blocking region. Under these conditions diac operates as an open switch. The voltages +VBO and –VBO are the breakdown voltages which are generally in the range of 30 to 50 volts. Once the positive or negative applied voltage is more than the respective breakdown voltages that	Expn3 Chara 4	7	

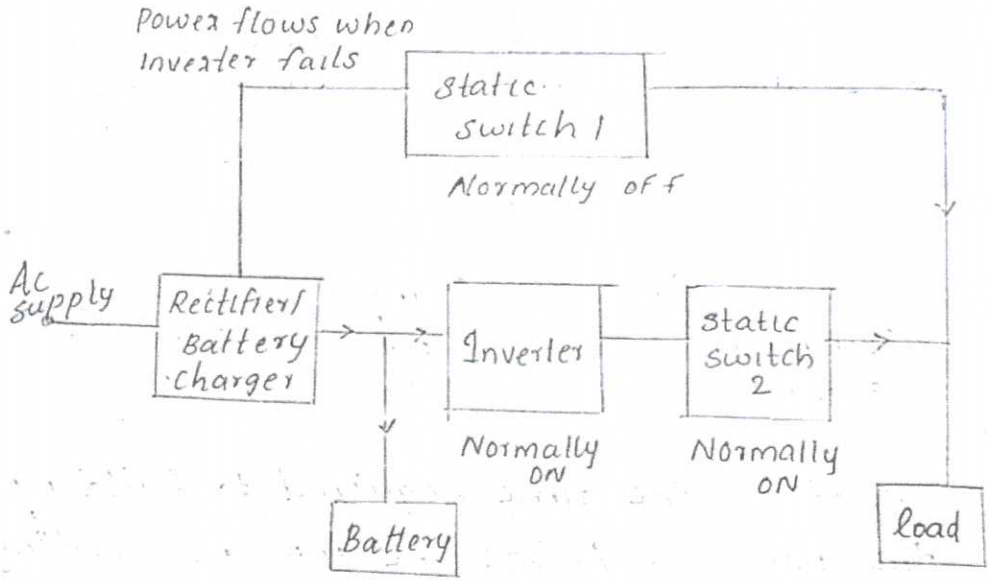
	means at point A in the above figure the diac begins to conduct and the voltage drop across the device becomes few volts. The portion AB represents the conduction of diac. This conduction continuous until the device current falls below its holding current level. From the figure it is noted that the holding current and breakover voltage values are are identical for reverse and forward region of operation.			
VII	  **Mode I** (0< t < t1): In this mode we give firing pulse to thyristor T1 and T1 get turned on and T2 is turned off. Current flow from Supply Vs …. T1…. ao (upper half of primary winding) …. back to Vs. As a result, Vs voltage is induced across upper as well as lower half of the primary winding of transformer. And Vs voltage is induced in secondary winding. **Mode II** (t1< t < t3): In this duration we give firing pulse to thyristor T2 and T2 get turned on. At this time capacitor start discharging through T1 therefore T1 turned OFF. This time current flow from supply Vs …. T2…. bo (lower half of primary winding) …. back to Vs. So, output voltage across load is Vs. **Mode III** (t3< t < t4): In this mode again, we give firing pulse to thyristor T1 and T1 get turned on. At this time capacitor start discharging through T2 therefore T2 turned OFF. This time current flow from supply Vs …. T1…. ao (upper half of primary winding) …. back to Vs. So, the total voltage across primary winding is 2Vs.	Expn3 Ckt:4	7	
VIII	 Step-up chopper works as a step-up transformer on DC current. This chopper is used when the output DC voltage has to be made higher than the input voltage. The working principle of a step up chopper can be explained from the above diagram. In the circuit, a large inductor L is connected in series to the supply voltage. Capacitor maintains the continuous output voltage to the load. The diode prevents the flow of current from load to source. When the chopper is	Ckt:4 Expn: 3	7	

	ON, supply voltage VS is applied to the load .i.e. V0 = VS and inductor starts storing energy. At this condition load current raises from Imin to Imax. When the chopper is switched OFF, the supply voltage takes the path from L – D – Load – VS. During this period the inductor discharges the stored e.m.f through diode D to the load. Thus the total voltage at the load V0 = VS + di/dt which s greater than the input voltage. Current changes from Imax to Imin.			
IX	  During the positive half cycle of the input,T1 conducts and during negative T2 conducts and I_L flows through R in same direction	Expn2 Ckt:3 Wave Form 2	7	
X		Expn3 Ckt:4	7	

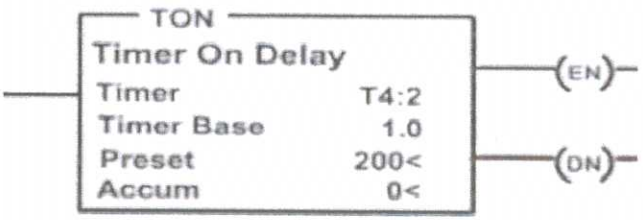




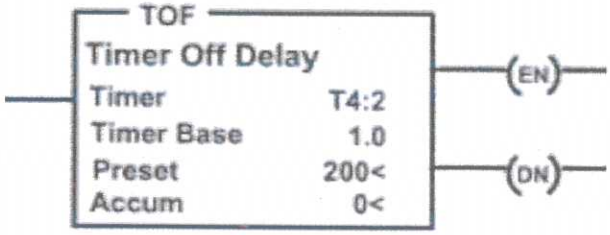
- We use single phase rectifier ckt for converting single phase AC into steady DC.
- The converter 1 consists of Rectifier. Then the rectified DC fed to a filter which removes pulses from rectified DC and converts it a pure DC by filtering.
- After that, this pure DC is fed to load and from the load, it is given to inverter ckt which converts this DC to AC and finally this AC of inverter taken as the output.

XI	 When the main supply is present, the rectifier/battery provides power to an inverter as well as battery. The battery is charged . The inverter is on and feeds power to the load through UPS static switch. The UPS static switch is always on and connects load to inverter output. The main static switch is always off. But when the UPS fails, then load is connected directly to the mains directly through mains static switch. When the mains supply is not available, then battery supplies power to an inverter. Thus the inverter is always on and it takes power from rectifier or battery.	Fig:4 Expn: 3	7	
XII	<table><tr><th>AC drives</th><th>DC drives</th></tr><tr><td>Used to control AC output</td><td>Used to control DC output</td></tr><tr><td>Speed control is done by changing the frequency</td><td>Speed control is done by armature control and field control</td></tr><tr><td>Frequent maintenance is required</td><td>Less maintenance</td></tr><tr><td>Have both convertor and inverter</td><td>Have a convertor</td></tr><tr><td>More expensive</td><td>Less expensive</td></tr><tr><td>Circuit complexity is high</td><td>Less</td></tr><tr><td>Consumes Low power</td><td>Consumes high power</td></tr></table>	7	7	
XIII	Timer instructions are 1. TIMER ON DELAY (TON) 2.TIMER OFF DELAY (TOFF) 3. RETENTIVE TIMER (RTO) 1. TIMER ON DELAY (TON) TON instruction begins to count time base intervals when the run condition becomes true. When the input is true the timer increments the accumulator value until it reaches the preset value. When the accumulator value reaches the preset	List:1 3X2	7	

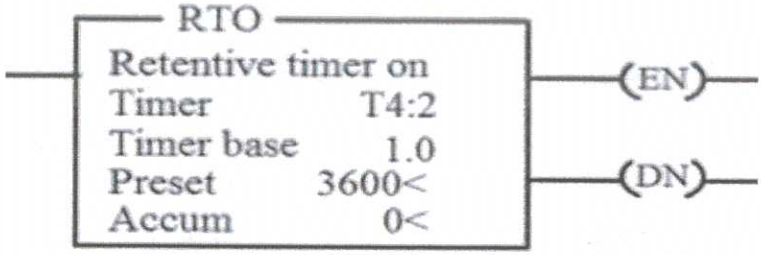
value then done bit (DN) becomes one.

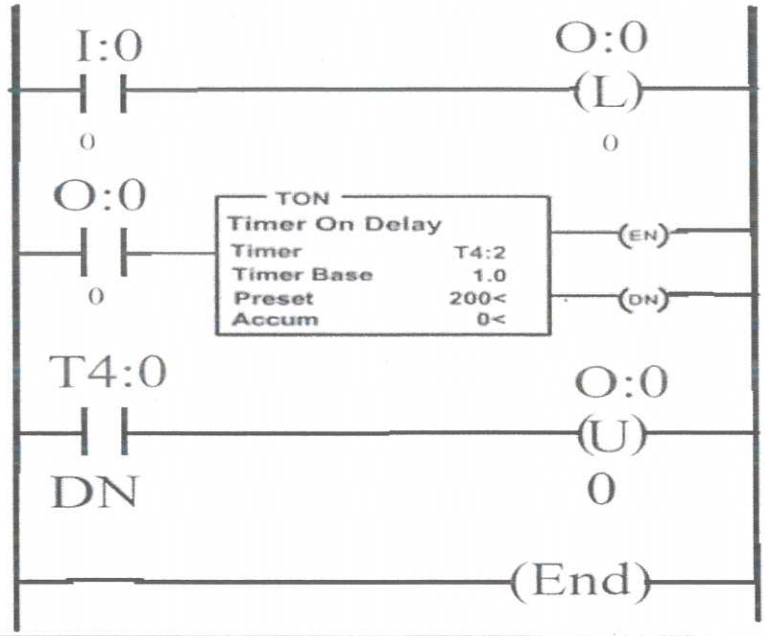


2. TIMER OFF DELAY (TOFF)
TOFF instruction begins to count time base intervals when the run makes a high to
low (1 to 0) transition. The timer increments the accumulator value with the time
base interval. When the accumulator value reaches the preset value then done bit
(DN) becomes one.



(3) RETENTIVE TIMER (RTO)
The RTO command is very sililar to TON and TOFF commands except for the fact that the accumulator value is retained even if the run condition goes false.



XIV	 I:0 0 O:0 (L) 0 O:0 0 TON Timer On Delay Timer T4:2 Timer Base 1.0 Preset 200 Accum 0 (EN) (DN) T4:0 DN O:0 (U) 0 (End)	7	7	