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Apr:l-24
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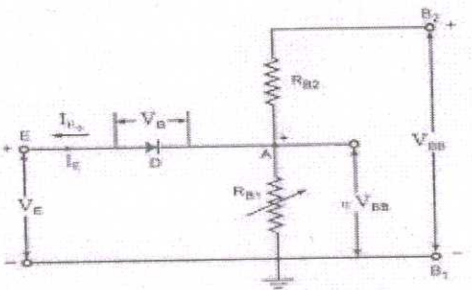
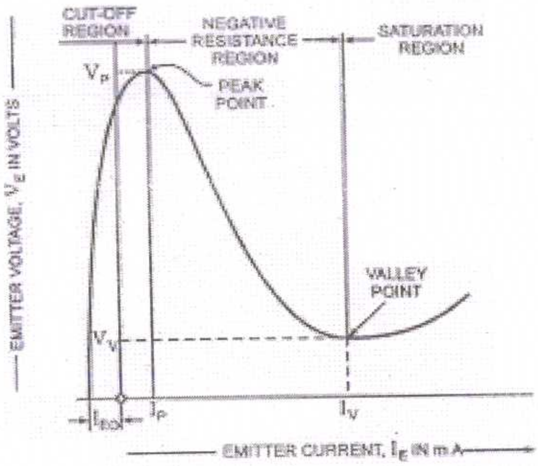
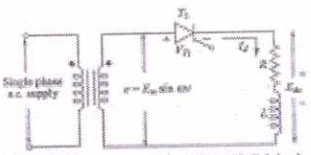
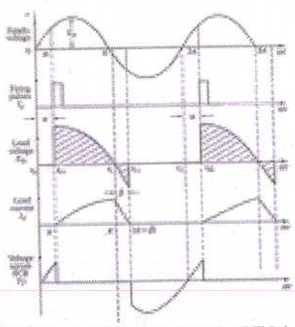
SCHEME OF VALUATION

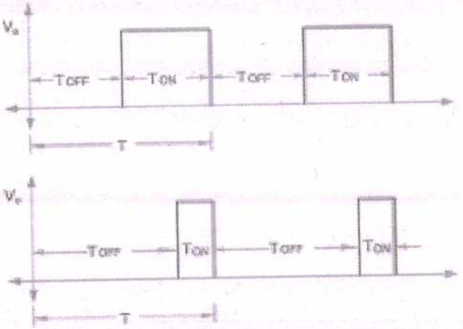
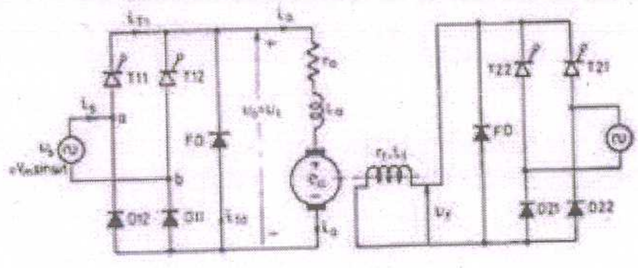
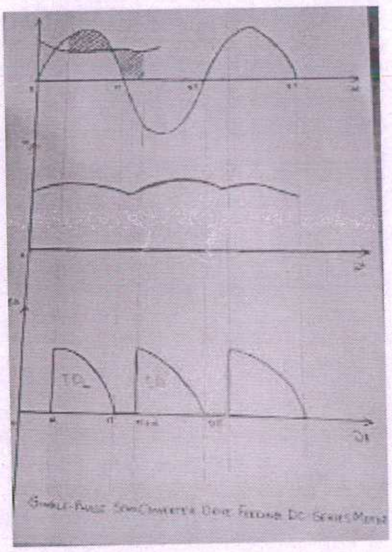
(Scoring Indicators)

Revision: **2015** Course Code: **5032**

Course Title: **POWER ELECTRONICS**

Qst. No	Scoring Indicator	Split up Score	Sub Total	Total
	PART A			
I (1)	The minimum anode current required to maintain a thyristor in on state immediately after a thyristor has been triggered on.	2x1	2	
I (2)	 *Equivalent Circuit of a UJT*	2x1	2	10
I (3)	The conversion of fixed DC voltage to a variable DC output voltage through the use of semiconductor device.	2x1	2	
I (4)	An electric motor together with its control equipment and energy transmitting device forms an electric drive.	2x1	2	
I (5)	1. OFFLINE UPS 2. ONLINE UPS 3. Line interactive UPS.	2x1	2	
	PART B			
II (1)	1. Cut-off region:- When VBB is applied a small leakage current starts flowing from B2 to E due to minority carriers in the reverse biased diode as indicating to the left of VE axis. As VE increases a forward IE begins to flow and increase up to peak point. 2. Negative resistance region:-	1		

	Once the forward emitter current establishes at VE=VP the emitter potential falls with increase in IE. The resistance will decrease until valley point is reached and is called negative resistance region.	1	6	
	3. Saturation region:- Any further increase in emitter current after valley point the device in saturation region.	1		
	 *Static Emitter-Characteristic For a UJT*	3		30
II (2)	 Fig.1(a) Half-wave controlled rectifier with R-L load 	4	6	
	. During positive half cycle thyristor is forward biased. . At wt = π, load voltage is zero but load current is not zero because of the load inductance L. . After ω=π, SCR is subjected to reverse anode voltage but it will not be turned off as load current is not less than the holding current. . At some angle β>π i0 reduces to zero and SCR is turned off. . After ωt = β , v_o=0 and i_o=0. . At ωt = 2π+α SCR is triggered again.	2		
II (3)	The average output voltage can be controlled through α by opening and closing the semiconductor switch periodically. In this scheme the on time T_{on} is varied but chopper frequency ,f (or chopping period T) is kept constant. The variation T_{on} means adjustment of pulse width. Ideally α can be varied from zero to infinity. This scheme is also called pulse width modulation or time ratio control.	3	6	

	 FIG A : CONSTANT FREQUENCY CONTROL (A) T_{ON} = T_{OFF} (B) T_{ON} = 1/4 T_{OFF}	3		
II (4)	 (a)	2		
	Semi controlled converter will have 2 SCR and 2 diodes. The armature is fed from a single phase full wave controlled rectifier with a freewheeling diode. The freewheeling diode is necessary to allow circulating current in the motor during off period of the SCR. The output voltage is zero when freewheeling diode is conducting.	2	6	
		2		
II (5)	**Stator Voltage Control** is a method used to **control** the speed of an **Induction Motor**. The speed of a **three phase induction motor** can be varied by varying the supply **voltage**. ... The torque developed is			

proportional to the square of the supply **voltage** and the current is proportional to the **voltage**.

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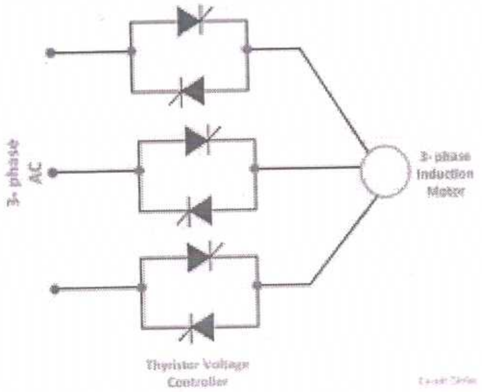

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II (6)

Sl no	particular	Linear PS	SMPS
1	efficiency	Low	High
2	Size	Large	Small
3	Weight	Heavy	Small
4	Circuit	Simple	Complicated
5	Sensitivity	High	Normal
6	Ripple	Small	Large
7	Transient response	Fast	Normal
8	Cost	Low	High
9	EMI	No	Yes

6x1 6

II (7)

Off line UPS passes the AC Mains Supply directly to the output load if the AC Mains Supply is present. Only in the case of power failure, it switches to inverter within few milliseconds to give power to load until mains supply returns.

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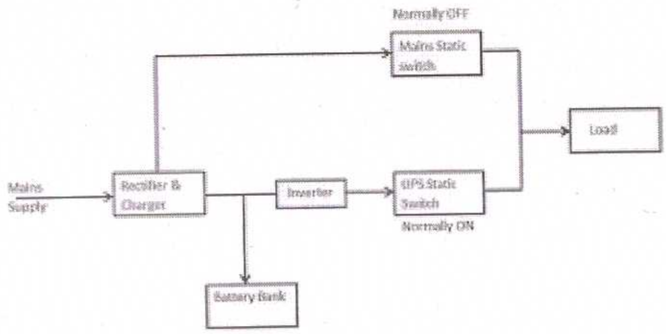

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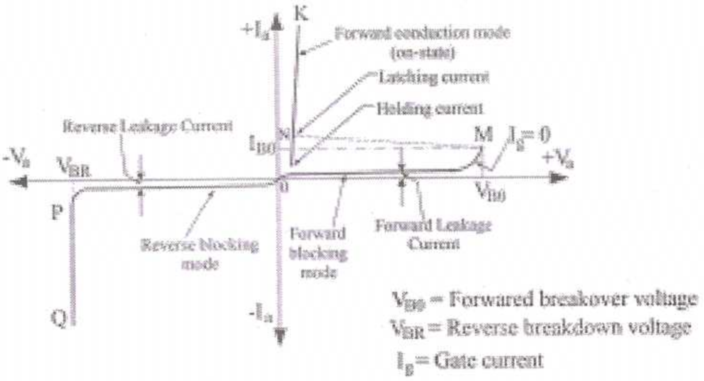
		3		

PART C

III (a)



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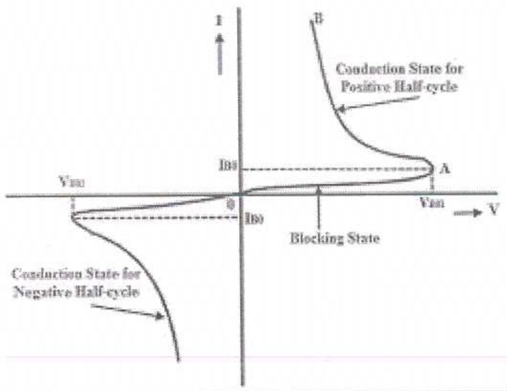
There are **three modes** in which **SCR** operates. Those are forward blocking, forward conduction **mode** and reverse blocking **mode**. 4

III (b)



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The **DIAC** is basically a diode that conducts after a 'break-over' voltage, selected VBO, and is exceeded. ... The holding current, the **DIAC** reverts to its non-conducting state. Its behaviour is bidirectional and thus its function takes place on both halves of an alternating cycle. 3

IV (a)

TRIAC
Mode 1: MT2 is Positive, Positive Gate Current.
Mode 2: MT2 is Positive, Negative Gate Current.
Mode 3: MT2 is Negative, Positive Gate Current.
Mode 4: MT2 is Negative, Negative Gate Current. 4

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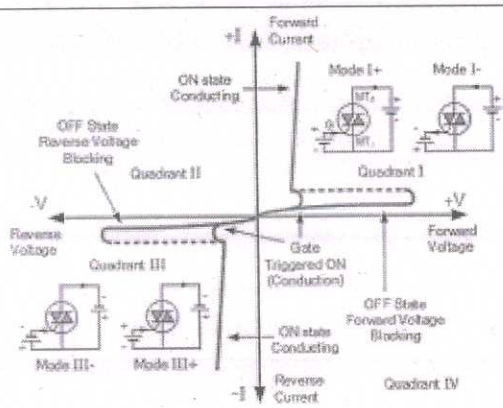

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IV (b)

For turning ON a N-channel JFET, positive voltage of VDD has to be applied to the drain terminal of the transistor w.r.t (with respect to) source terminal such that the drain terminal must be appropriately more positive than the source terminal. Thus, current flow is allowed through the drain to source channel. If the voltage at the gate terminal, VGG is 0V, then there will be maximum current at the drain terminal and N-channel JFET is said to be in ON condition.

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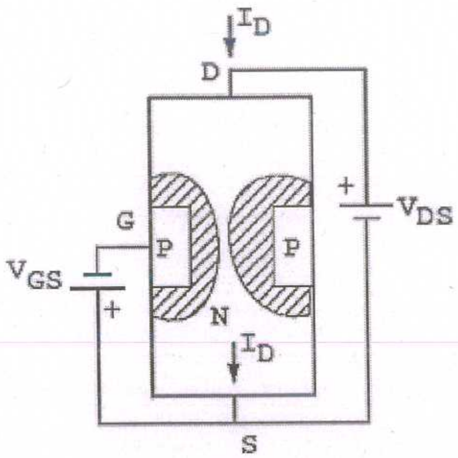

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V (a)

Single Phase Half Wave **Controlled Rectifier with RL Load and Freewheeling Diode** The circuit consist of a thyristor T, a voltage source Vs, a• **diode** FD across the **RL load**, an inductive **load** L and a resistive **load** When the current is shifted from thyristor to•R. ... **freewheeling diode**, the thyristor turns OFF.

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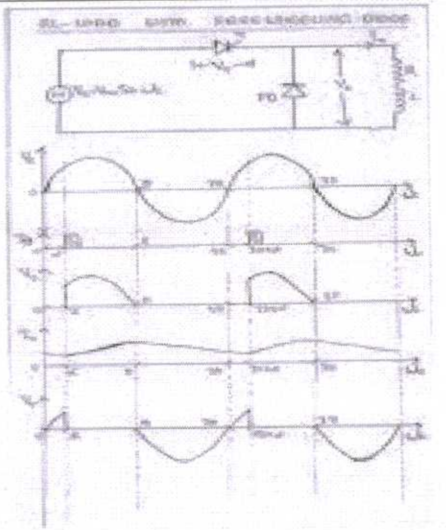
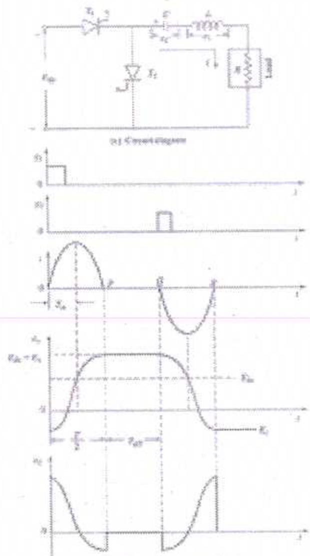
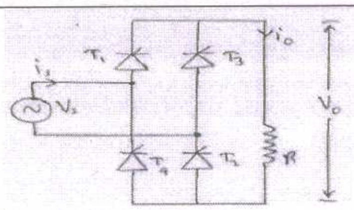
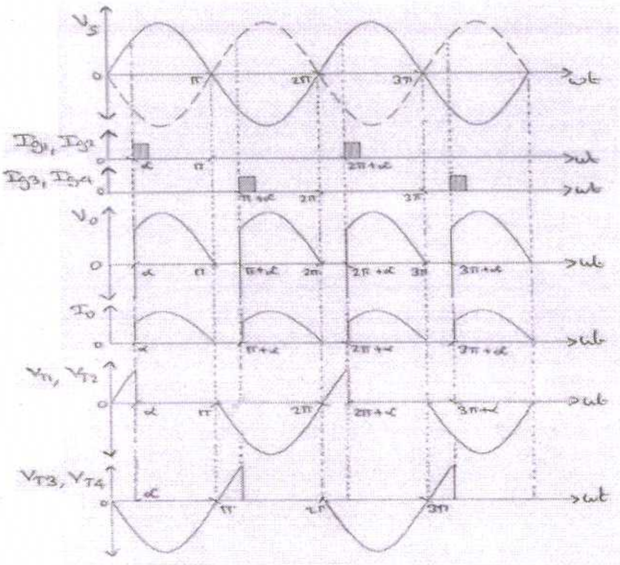
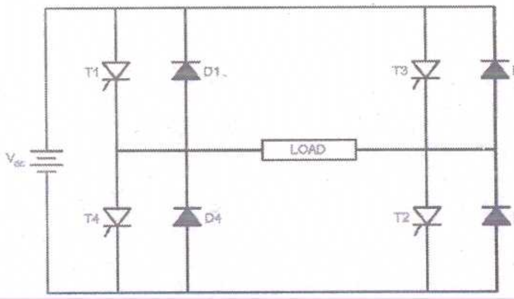
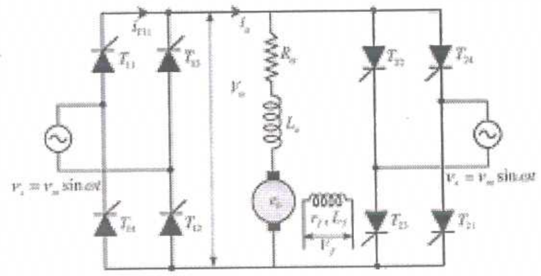
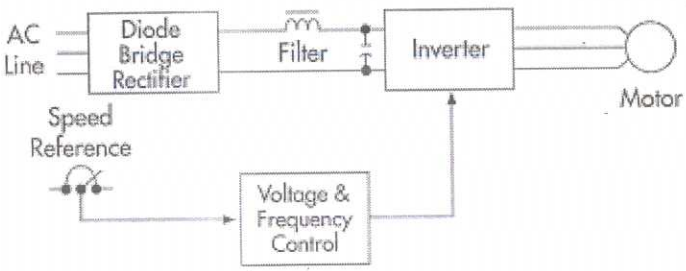
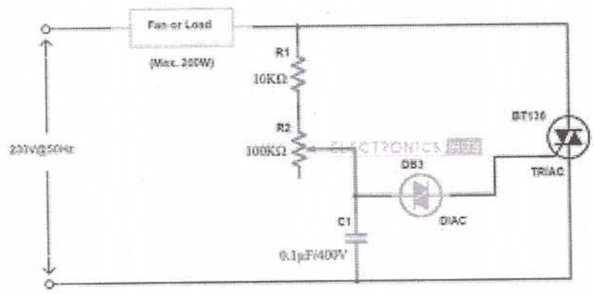
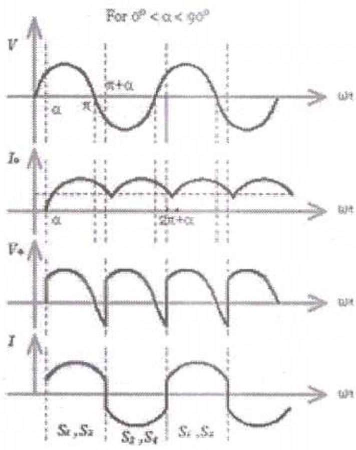
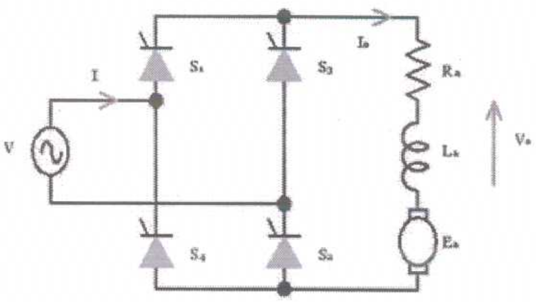
		4		60
V(b)	The **inverter** plays a vital role in Uninterrupted Power Supply (UPS). It is used to convert the direct current (DC) to alternating Current (AC) of required voltage. In **series inverter**, the commutating elements L and C are connected in **series** with the load. This constitutes a **series** RLC resonant circuit.	3	7	
	 (b) Voltage and current waveforms Fig.1 Series inverter	4		
VI (a)	The **single phase fully** controlled **rectifier** allows conversion of **single phase** AC into DC. Normally this is used in various applications such as battery charging, speed control of DC motors and front end of UPS (Uninterruptible Power Supply) and SMPS (Switched Mode Power Supply)	4		

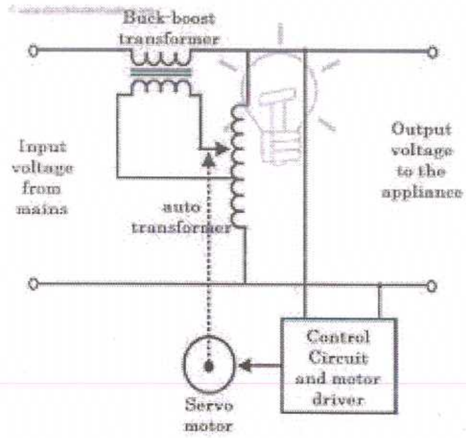
Q. No.	Answer	Marks	Total
	1φ full wave bridge converter (fully controlled) R - LOAD  	4	8
VI (b)	 FIGURE A : SINGLE PHASE FULL BRIDGE INVERTER	4	7
	A **single-phase** square **wave** type voltage source **inverter** produces square shaped output voltage for a **single-phase** load. ... Accordingly, it is assumed that the input dc voltage (Edc) is constant and the switches are lossless. In **full bridge** topology has two such legs.	3	
VII (a)	**Dual Converter** is an **Electronic** Device or Circuit made by the combination of two bridges. One of them works as **Rectifier**(Converts A.C. to D.C.) and other bridge works as Inverter(converts D.C. into A.C.). Thus an **electronic** circuit or device in which two processes take place at same time, is known as **Dual Converter**.	4	

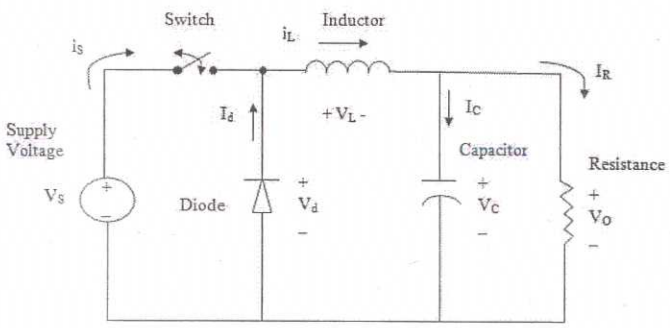
<table>
<tr><td></td><td>Fig. 5. Single phase fully controlled converter drive
</td><td>4</td><td>8</td><td></td></tr>
<tr><td>VII(b)</td><td>Stator frequency control
Note that in order to reduce the speed, frequency has to be reduced. ... Actually, it is the voltage across the magnetizing branch of the exact equivalent circuit that must be maintained constant, for it is that which determines the induced emf. ...
synchronous speed by a fixed difference, independent of frequency.</td><td>3</td><td rowspan="2">7</td><td></td></tr>
<tr><td></td><td>
</td><td>4</td><td></td></tr>
<tr><td>VIII (a)</td><td>Solid state fan regulators/ motor controllers eliminate the limitations of fixed fan/motor speed using tapped resistance/reactor. ... Standard tapped resistance fan regulators dissipate power in resistance & allows less power for fan to reduce speed of fan. For lower speed of fan power is wasted in resistance.</td><td>3</td><td rowspan="2">7</td><td></td></tr>
<tr><td></td><td>
</td><td>4</td><td></td></tr>
<tr><td>VIII(b)</td><td>The single phase fully controlled rectifier allows conversion of single phase AC into DC. Normally this is used in various applications such as battery charging, speed control of DC motors and front end of UPS</td><td>4</td><td></td><td></td></tr>
</table>

<table>
<tr><td></td><td>(Uninterruptible Power Supply) and SMPS (Switched Mode Power Supply).



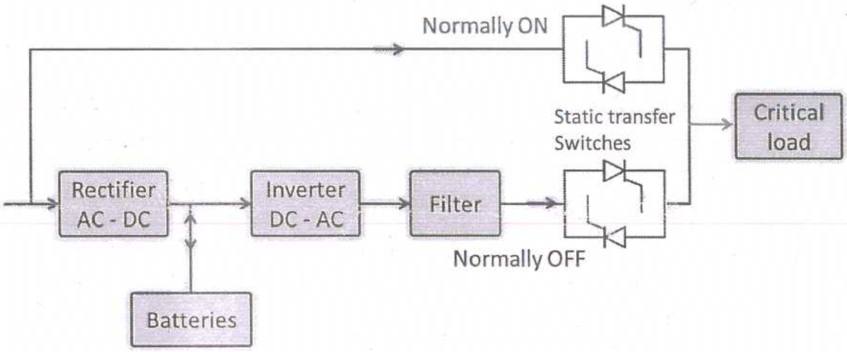

</td><td>4</td><td>8</td><td></td></tr>
<tr><td>IX (a)</td><td>A Servo Stabilizer is a Servo motor controlled stabilization system that performs optimum voltage supply using a Buck\Boost transformer booster that captures voltage fluctuations from input and regulates current to the correct output.


</td><td>3
4</td><td>7</td><td></td></tr>
<tr><td>IX(b)</td><td>A Buck converter is a switch mode DC to DC electronic converter in which the output voltage will be transformed to level less than the input voltage. It is also called as step down converter.


</td><td>4
4</td><td>8</td><td></td></tr>
<tr><td>X(a)</td><td>UPS. (Uninterruptible Power Supply) A device that</td><td></td><td></td><td></td></tr>
</table>

provides **battery** backup when the electrical power fails or drops to an unacceptable voltage level. Small **UPS systems** provide power for a few minutes; enough to power down the computer in an orderly manner, while larger **systems** have enough **battery** for several hours. 4

Online UPS's take the Incoming AC mains Supply and Convert it to DC which Feeds the Battery and the Load Via the Inverter. 8



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X(b)

Sl no	particular	Linear PS	SMPS
1	efficiency	Low	High
2	Size	Large	Small
3	Weight	Heavy	Small
4	Circuit	Simple	Complicated
5	Sensitivity	High	Normal
6	Ripple	Small	Large
7	Transient response	Fast	Normal
8	Cost	Low	High
9	EMI	No	Yes

7x1 7