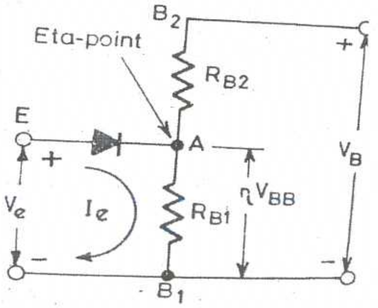
SCHEME OF EVALUTION

(Scoring Indicators)

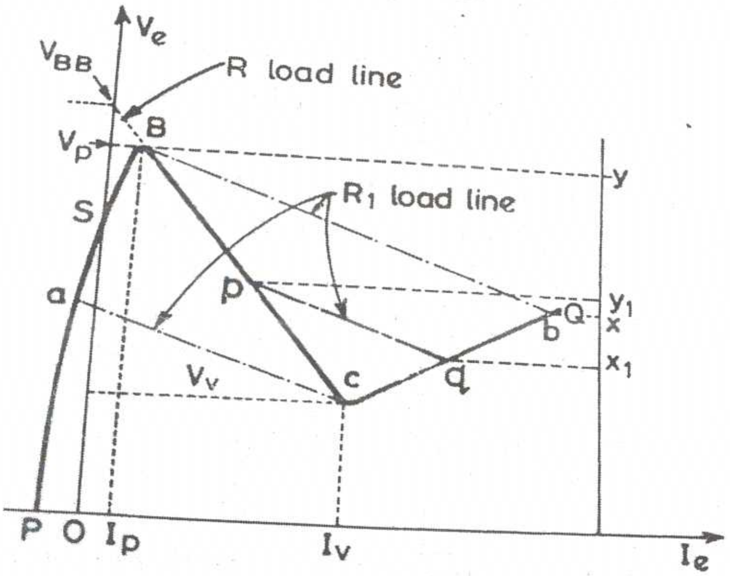
Revision : 2015
Course Code : 5032
Course Title : Power Electronics

Qst. No.	Scoring Indicators	Split Up Score	Total
I	PART - A		
1		2	2
2	1. Light dimming control. 2. Motor speed control. 3. Phase control. 4. Minimizing radio interference. 5. As static switch to turn .	Any two	2
3	1. To eliminate negative voltage at output. 2. To get output current continuous. 3. For the protection of SCR.	Any two	2
4	1. Stator voltage control. 2. Stator frequency control. 3. Stator voltage and frequency control.	Any two	2
5	1. Electromagnetic interference. 2. Control circuit is expensive. 3. Higher output ripple and noise. 4. The main supply voltage causes disturbances in other devices in close proximity.	Any two	2

II

PART – B

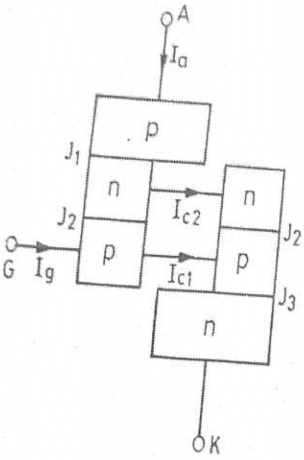
1.

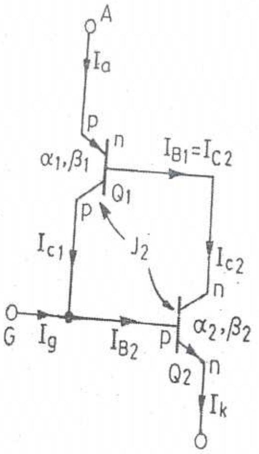


4

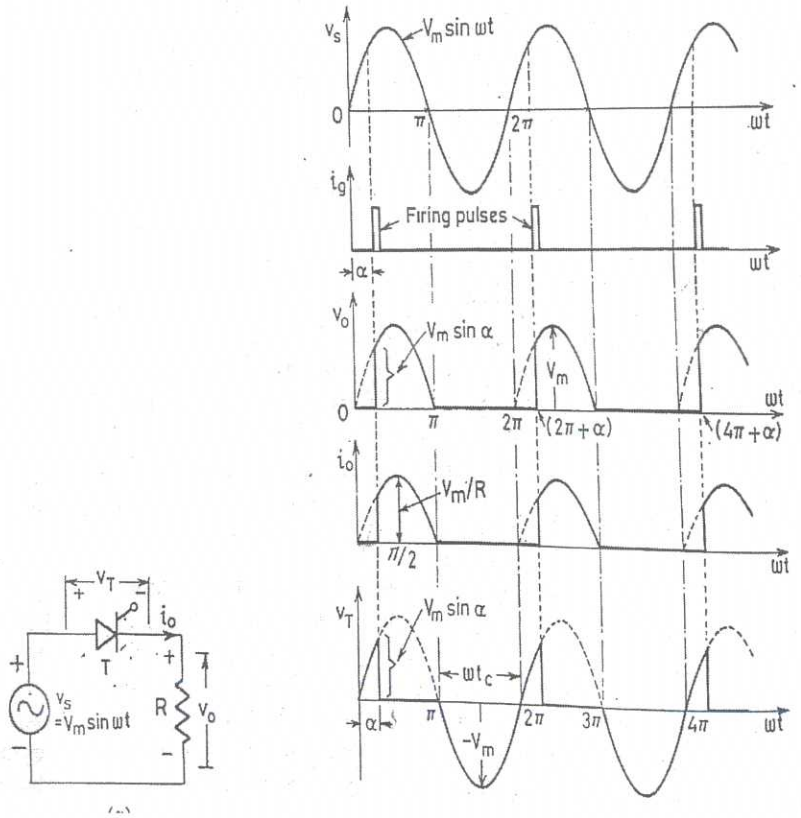
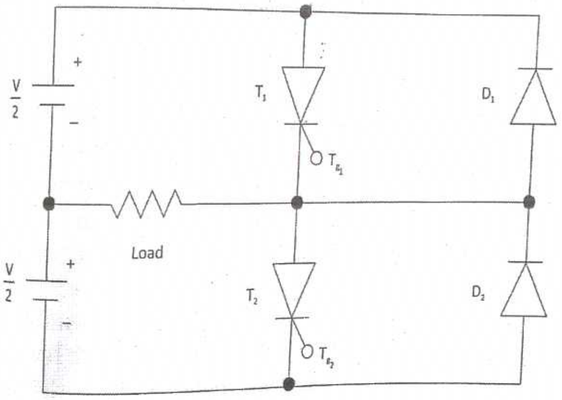
Marking points : Vp, Vv, Ip,Iv 2 6

2.





Any one Fig. 6

3.			
	Circuit	3	
	Waveform	3	6
4		3	
	0 < t ≤T/2 , T1 conducts and load is subjected to a voltage Vs/2 T/2 < t ≤T , T2 conducts and load is subjected to a voltage -Vs/2 The load voltage is an alternating voltage wave form of amplitude Vs/2 and frequency 1/T Hz.	3	6

<table>
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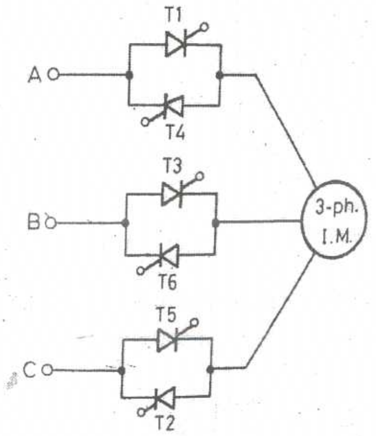
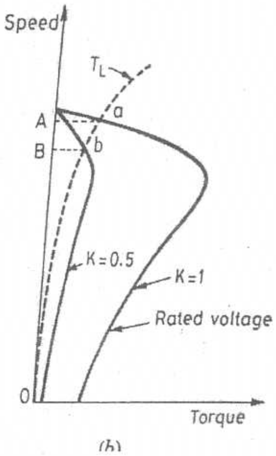
<td>5</td>
<td>




(b)
</td>
<td>3+3</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>
<table>
<tr><th>Parameter</th><th>Linear power supply</th><th>SMPS</th></tr>
<tr><td>Size</td><td>Large</td><td>Small</td></tr>
<tr><td>Weight</td><td>Heavy</td><td>Light</td></tr>
<tr><td>Efficiency</td><td>Poor
(25 – 50%)</td><td>Good
(65 – 80%)</td></tr>
<tr><td>Operating cost</td><td>High</td><td>Low</td></tr>
<tr><td>Main transformer</td><td>Bulky</td><td>Small</td></tr>
<tr><td>Noise level at output</td><td>Low</td><td>High</td></tr>
<tr><td>Filter Capacitor</td><td>Bulky</td><td>Medium</td></tr>
<tr><td>Transformer core</td><td>Laminated iron</td><td>Ferrite core</td></tr>
<tr><td>RF interference</td><td>Special shielding should be provided</td><td>Negligible</td></tr>
</table>
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7

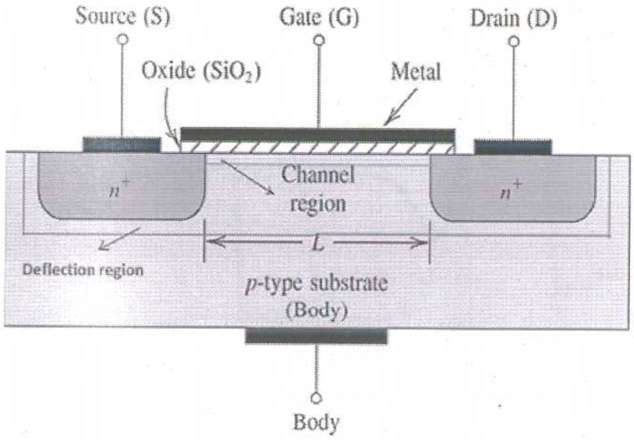
Buck Converter	Boost converter
The output voltage is less than the input voltage	The output voltage is more than the input voltage
It can be used as a step down transformer	It can be used as a step up transformer
Poor PF correction	High PF correction
Large filter required	Small filter required

6 6

III

PART _ C

(a)



5

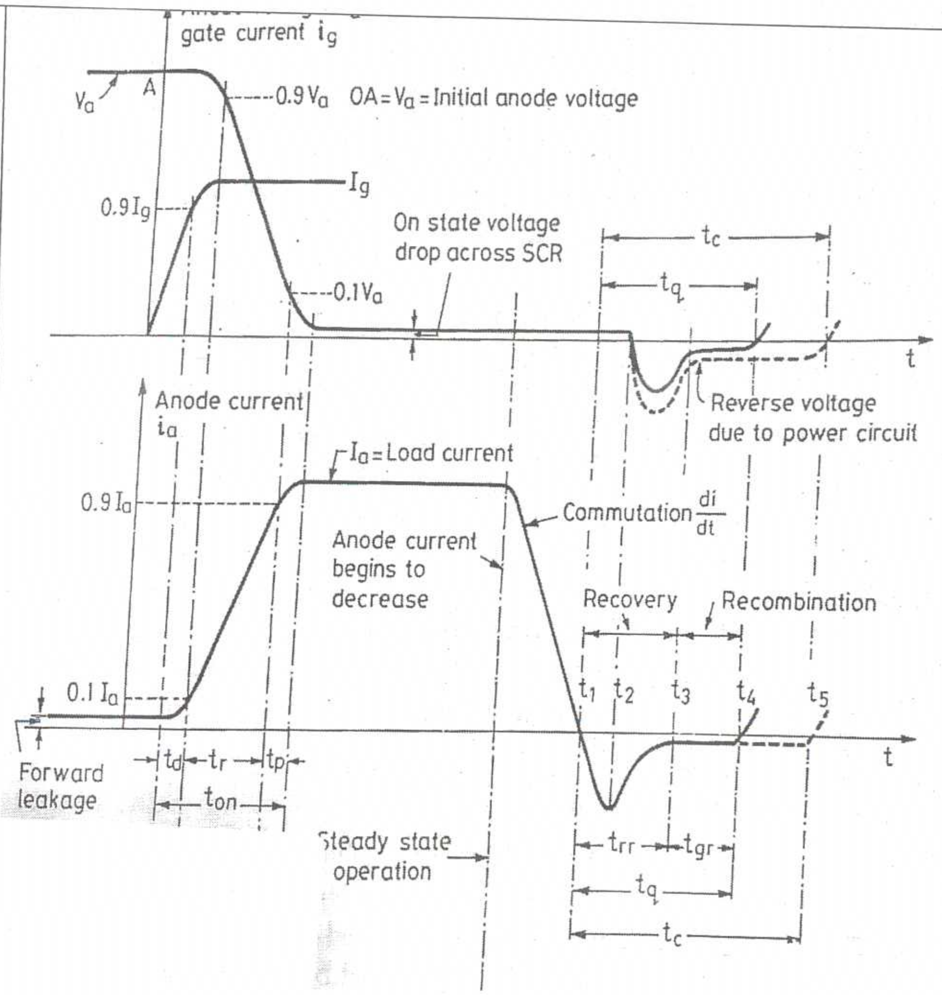
No channel between source and drain. When positive voltage applied to the gate creates a channel in between drain and source due to the capacitive effect of silicon dioxide . 3 8

(b)

Voltage triggering
Gate triggering
dv/dt triggering
Temperature triggering
Light triggering 3

Explnation 4 7

IV
(a)

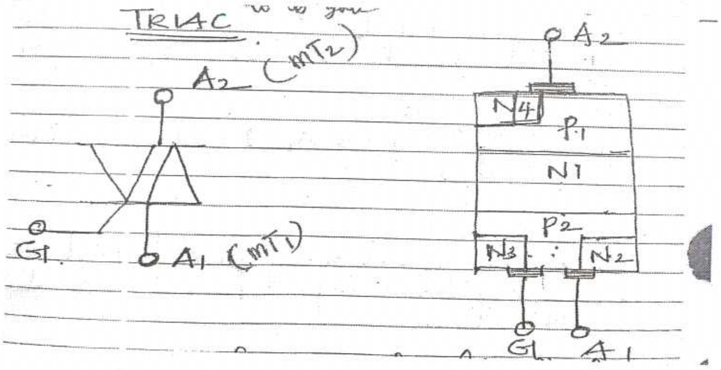


5

td -Delay time tr – Rise ime tp - Spread time
trr – Reverse recovery time tgr – Gate recovery time
tc – Commutation time

3 8

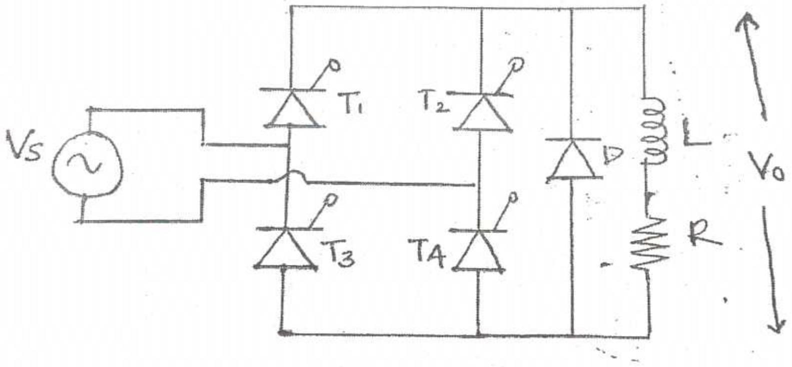
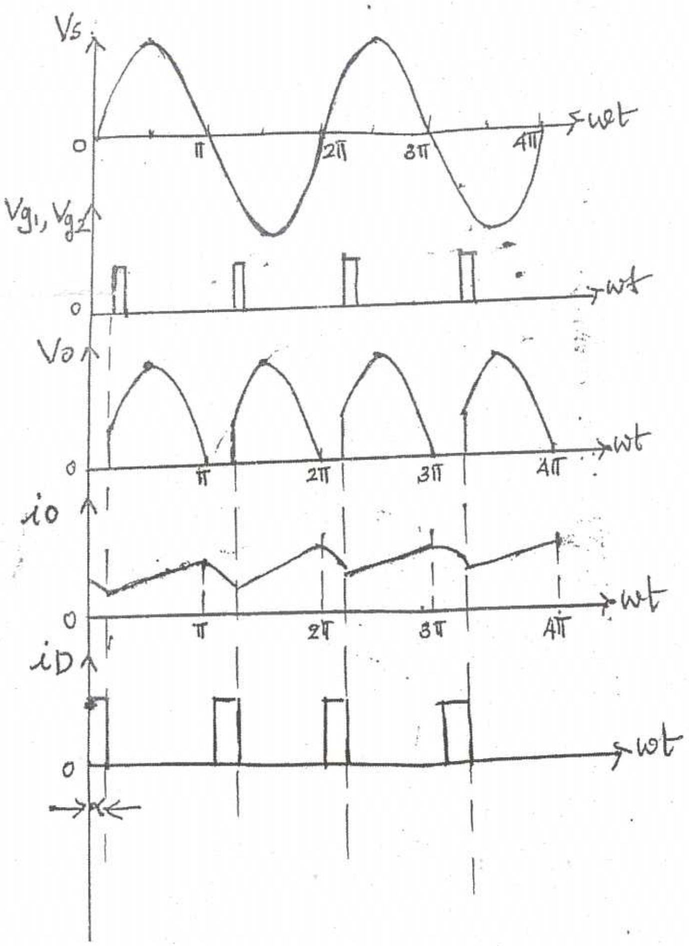
(b)

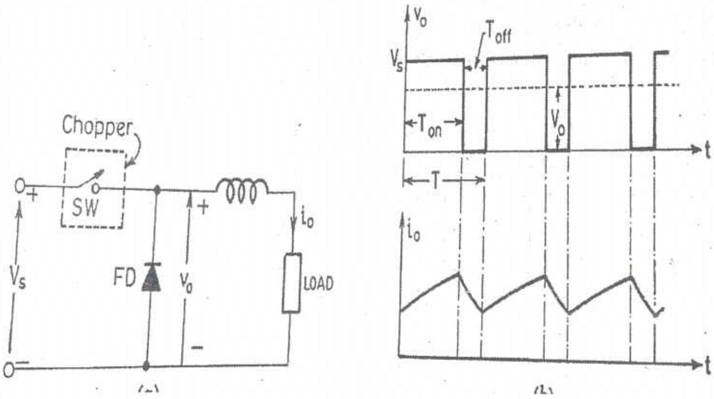
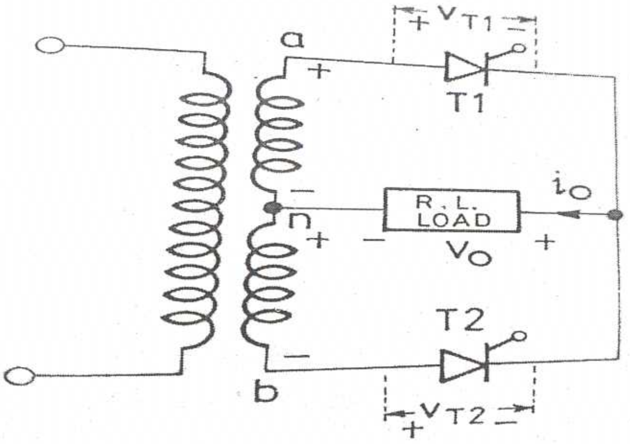


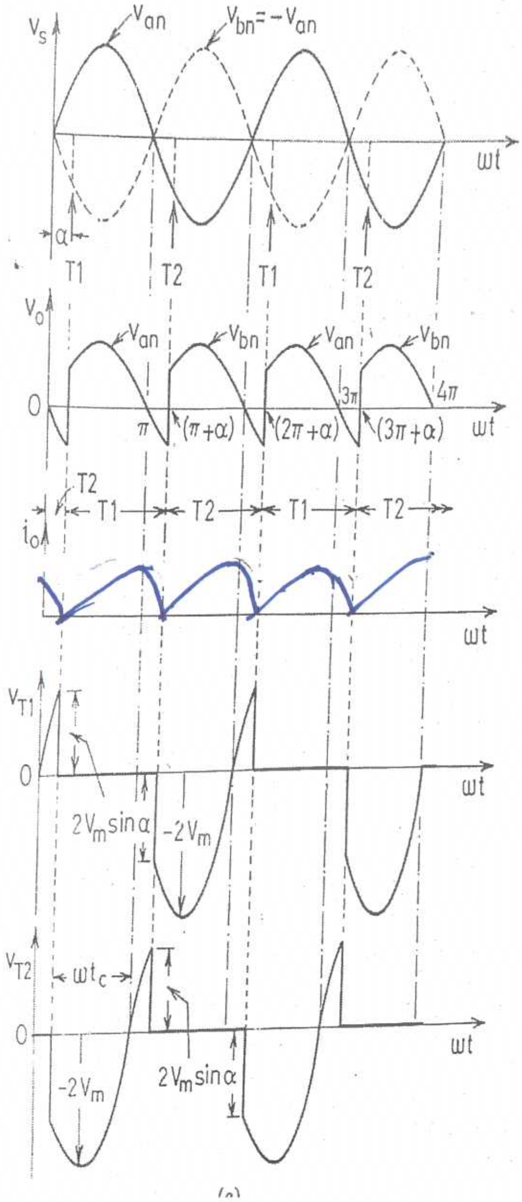
4

It can be triggered in to conduction by both +ve end –ve voltages at its anode and both +ve end –ve voltages at its gate.

(1) When A2 is +ve current path is P1-N1-P2-N2
+ve gate voltage forward biases P2-N2 junction
-ve gate voltage forward biases P2-N3 junction and current

	carriers injected to P2 to turn ON the scr. (2) When A1 is +ve, current path is P2-N1-P1-N4 +ve gate injects current carriers by forward biasing P2-N2 junction -ve gate injects current carriers by forward biasing P2-N3 junction.	3	7
V (a)		4	
		4	8

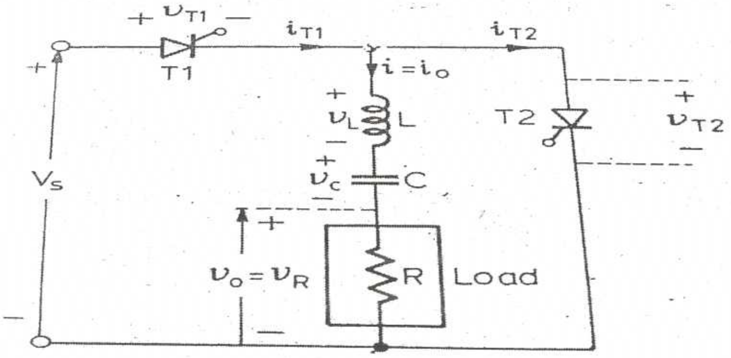
(b)		4	
	A chopper is a high speed ON-OFF semiconductor switch. During Ton chopper is ON and load voltage equals source voltage. .During Toff chopper is OFF , load current flowing through the freewheeling diode. As a result load terminals are short circuited by diode and load voltage is zero. Load current is continuous and average load voltage is $V_0= T_{on}.V_s/T_{on}+T_{off}.$ $=T_{on} . V_s/T$ $= f. T_{on}. V_s$ F=1/T called chopping frequency.	3	7
VI (a)		4	


v_s
v_{an}
$v_{bn} = -v_{an}$
ωt
α
T1
T2
T1
T2
v_o
v_{an}
v_{bn}
v_{an}
v_{bn}
0
π
(π+α)
(2π+α)
3π
4π
(3π+α)
ωt
T2
T1
T2
T1
T2
i_o
ωt
v_{T1}
0
$2V_m \sin\alpha$
$-2V_m$
ωt
v_{T2}
ωt_c
0
$-2V_m$
$2V_m \sin\alpha$
ωt
(a)

4

8

b)


$+ \ v_{T1} \ -$
T1
i_{T1}
i_{T2}
$i = i_o$
+
v_L
L
−
+
v_c
C
+
V_s
−
+
$v_o = v_R$
−
R
Load
T2
+
v_{T2}
−

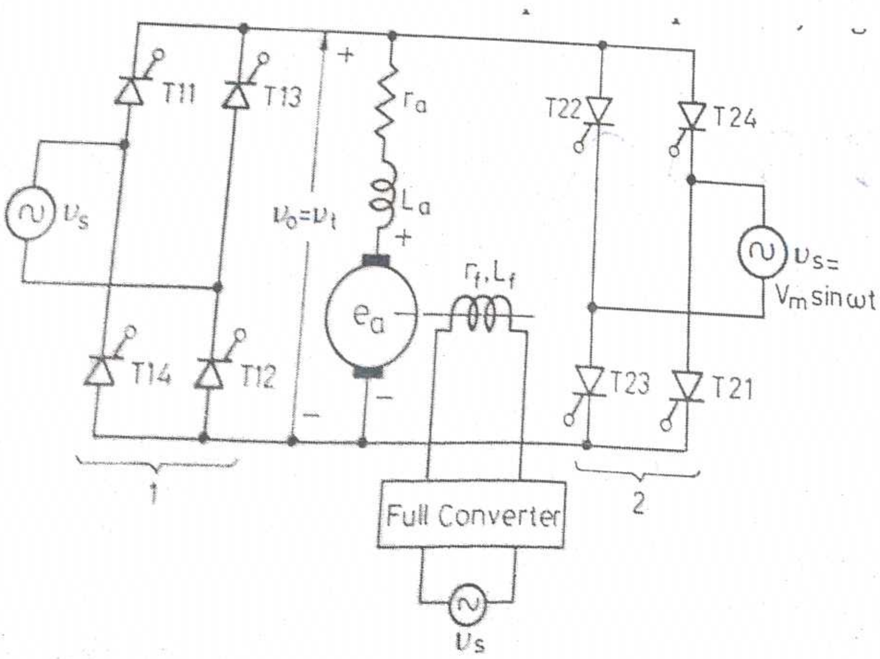
4

Commutating components are permanently connected in series with the load. Two thyristors T1 and T2 are turned ON appropriately. So that output voltage of desired frequency can be obtained.
When thyristor T1 is turned ON with T2 OFF , current starts building up in the RLC circuit. The load current after reaching some peak value decays to zero and the current tends to reverse, T1 s turned OFF. When T2 turned ON capacitor begins to discharge and load current in the reversed direction. There is a delay between turning Off T1 and turning ON T2

3

7

VII (a)



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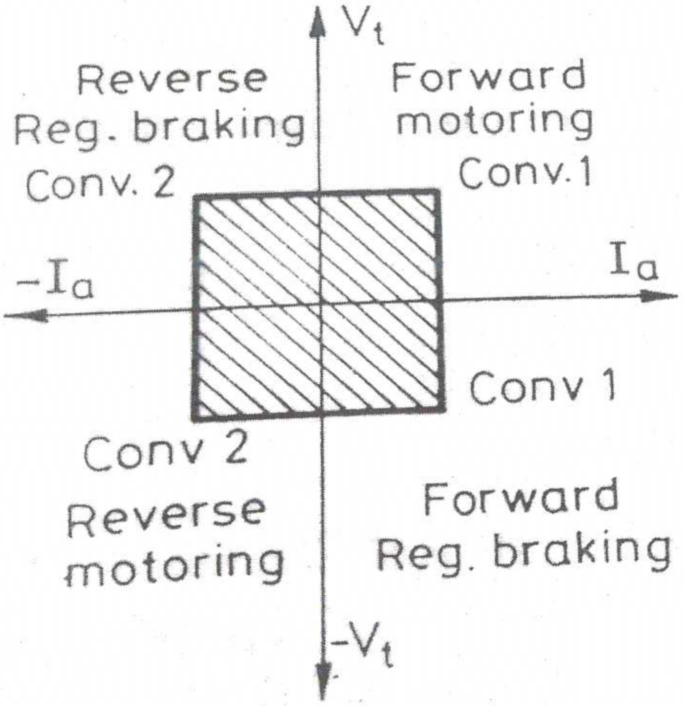

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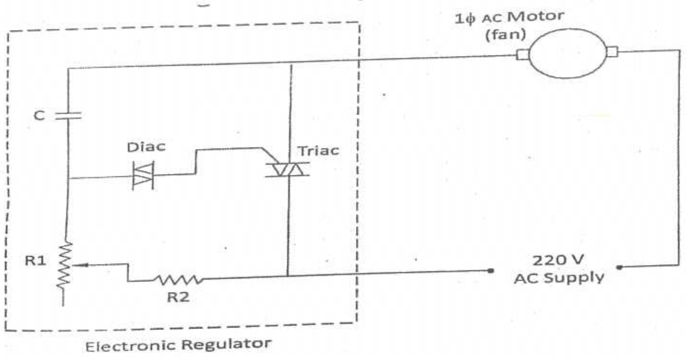
8

(b)

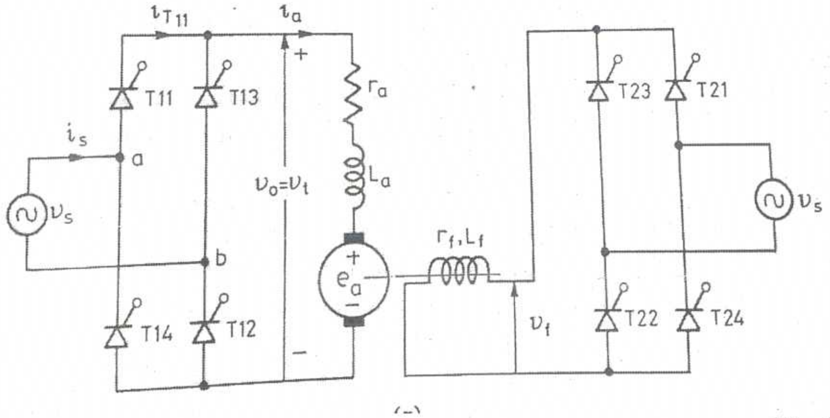
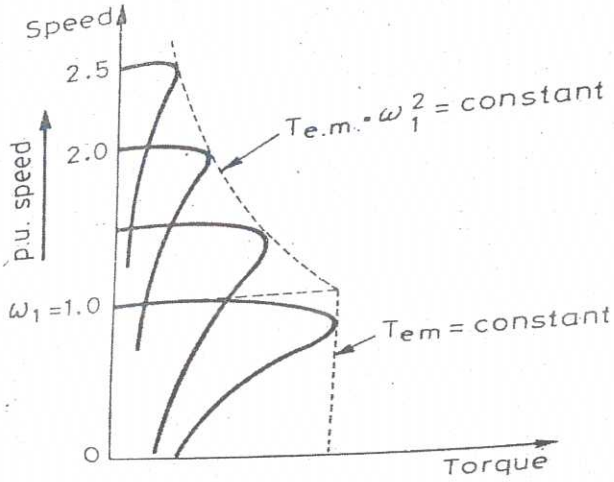


4

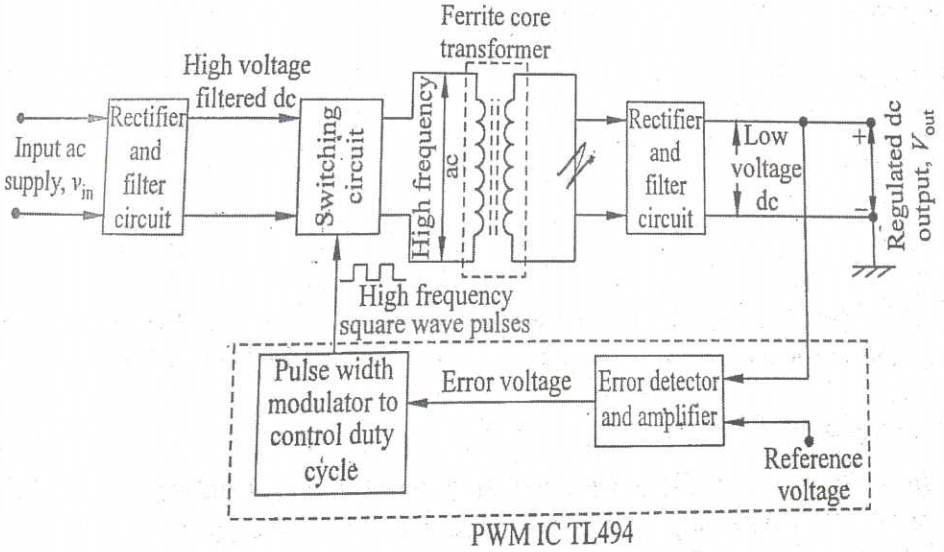
7

By varying resistor R1 the gate voltage of triac can be varied through diac and then speed can be varied.

3

VIII (a)	 Explanation	4 4	8
(b)	 By changing supply frequency, motor speed can be altered and thus torque and speed of a three phase induction motor can be controlled. For a three phase induction motor per phase supply voltage is V1= 4.44Øf1N1Kω	4 3	7

IX
(a)



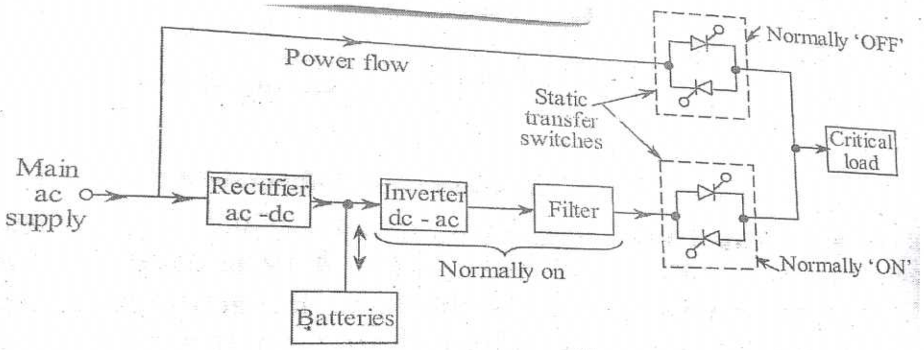
8 8

(b)

1. Physical preventive maintenance:- Checking all the connections. Poor connection will generate temperature.
2. Protection settings and calibration :- Protection settings like over voltage, alarms, battery conditions etc. and also calibration.
3. Functional load testing :- Steady state load testing, Harmonic analysis, Filter integrity, Transient response load test, Module test and Battery run-down test.

7 7

X
(a)

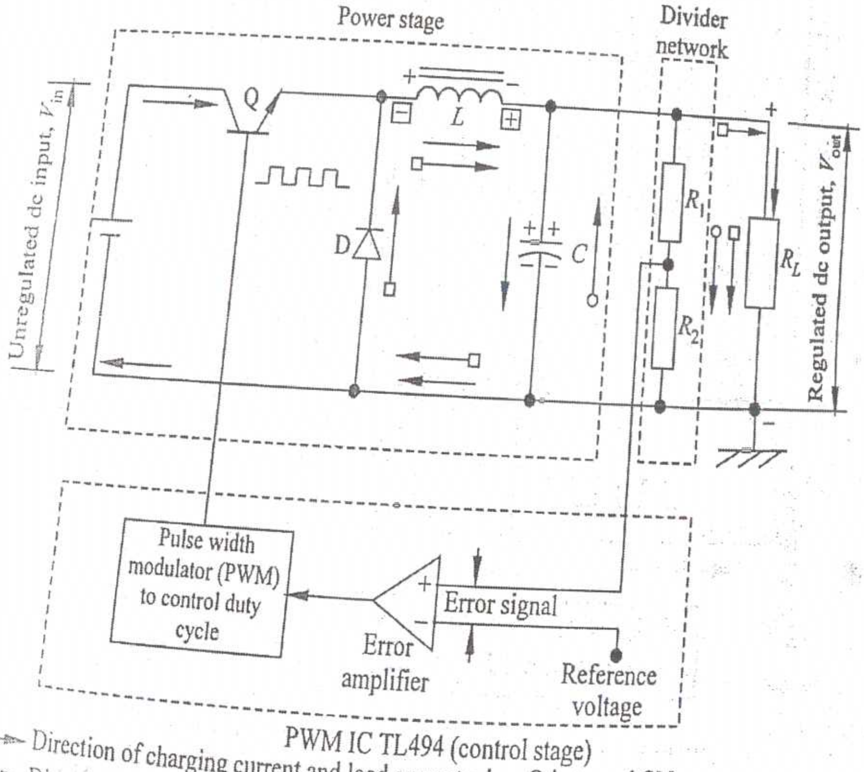


4

Explanation

4 8

(b)



→ Direction of charging current and load current when Q is turned ON

□→ Direction of load current when Q is turned OFF

○→ Direction of discharging current when the stored energy in L is completely exhausted

+ , − polarities in inductor correspond to Q ON

⊞ ,⊟ polarities in inductor correspond to Q OFF

4

Principle of Operation

When the transistor switch Q is turned on by the positive output pulse of the PWM, current flows through the inductor L and divides itself into two parts—one flowing through the output capacitor C and the other through the load R_L. As the transistor starts conducting, the induced voltage in the inductor L bucks (opposes) the input voltage as illustrated in Fig. 1.19(b). When the output voltage V_{out} exceeds the input voltage V_{in}, the transistor switch Q is turned off by the negative output pulse of the PWM. At this instant, the stored energy in the inductor L reverses its polarity, and sends current into the load via diode D while the voltage is maintained by the capacitor C. As all the stored energy in the inductor is being used up, the capacitor discharges and the output voltage decreases. The diode D prevents the discharge of capacitor C through it. In this condition the switch Q is turned on and the process continues so that the output voltage is maintained very near to the input voltage V_{in}. Without the diode D, the inductive kick would develop enough reverse voltage to destroy the transistor.

If the output voltage increases because of any decrease in load, the error voltage will increase too. This enhanced error voltage reduces the ON time of the switching transistor Q, thereby reducing the output voltage to the desired value. The output voltage is also maintained at its desired value if it tends to decrease because of an increase in load. 3 7