(068-298) WK 11

8 TUESDAY • MARCH • 2016

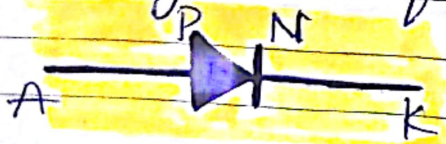
FEBRUARY 2016

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

Paper - II

PN junction diode

By themselves P-type and N-type taken seperately are of very limited use, if we join a piece of P-type to a piece of N-type semiconductor such that the crystal structure remains continuous at the boundary a PN junction is formed, such a junction makes a very useful device called PN junction diode or simply semi-conductor diode. cd diode has two terminals anode and cathode, the P region is the anode and the N region the cathode, it is represented by the foll. symbol in circuits,



Sometimes you have to hold several hands when your goal is far enough.

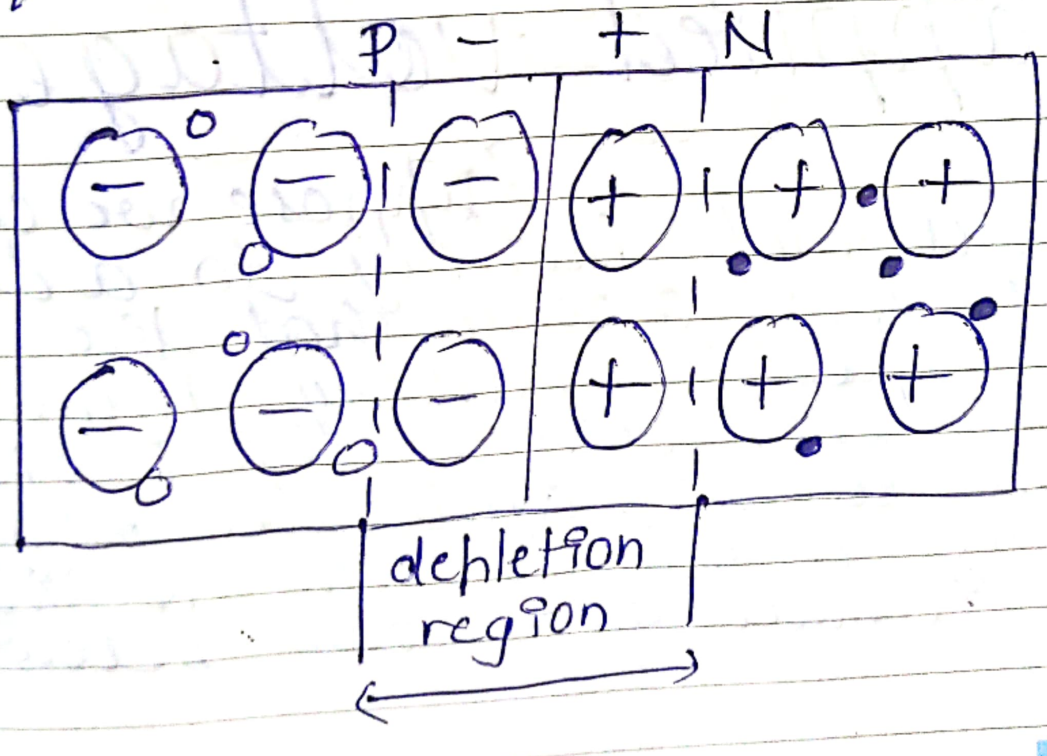
PN junction

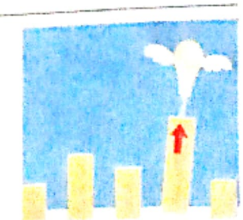
when there is no applied voltage or it is just formed

Consider a PN junction just immediately after it is formed, P region has **holes** a majority carriers while N-region has free **electrons** as majority carriers, holes and free e⁻ are the mobile charges while ions are immobile, the instant a PN junction is formed, holes and free e⁻ diffuse across the junction this is because they move randomly due to thermal energy and also due to a difference in their concentrations in the two.

regions, therefore, near the junction, there are a large no. of free e⁻ and holes in both P and N type regions, therefore there is a possibility of a free e⁻ combining with a hole, this combination is called recombination process. When a recombination takes place a free e⁻ occupies the hole and both hole and free e⁻ is lost due to many such recombinations close to the junction mobile carriers are lost and the overall result is that there is a positive charge on the N-side of the junction and a negative charge on the P-side, these charges are respectively due to the positive and negative ions that are immobile, this region at the junction having a depletion or absence of mobile carriers with only uncompensated positive and negative ions is called

depletion region. Once this region is formed free e⁻ on the N-side cannot cross the junction because they are repelled by the uncompensated negative ions, similarly holes cannot cross-over to the N-side repelled by uncompensated positive ions this after a few recombinations in the immediate neighbourhood of the junction a barrier is set-up, this barrier prevents further diffusion of holes and free e⁻ across the junction.





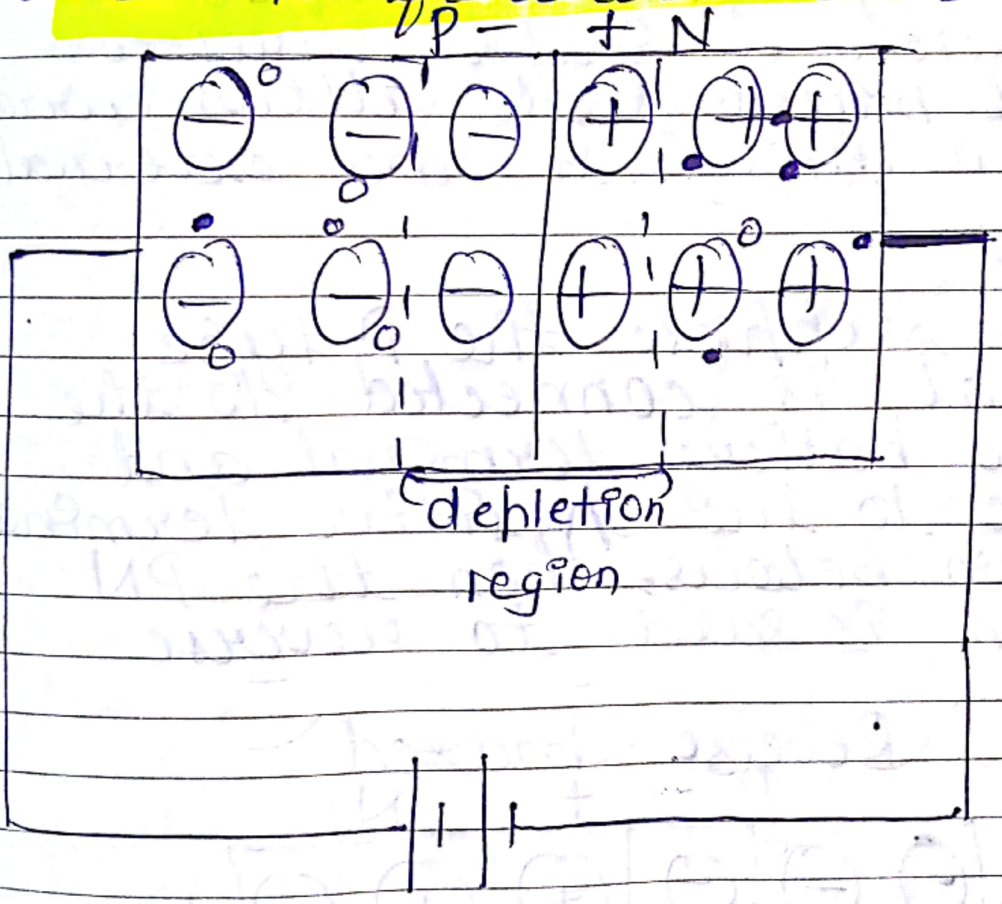
When you begin to think high idea emerges on its own.

This depletion region is also called the "space charge region because it has ion-mobile ions which are electrically charged, the depletion region works as a barrier and has a barrier potential of about 0.7V for silicon and about 0.3V for Germanium diodes.

PN junction with applied voltage

Suppose we connect an external battery to a diode in such a way that the positive battery terminal is connected to the P-side and anode and the negative battery terminal to the N-side or cathode as shown below then

the diode is said to be forward biased, in other words whenever the anode terminal is at a higher potential than the cathode the diode is forward biased.



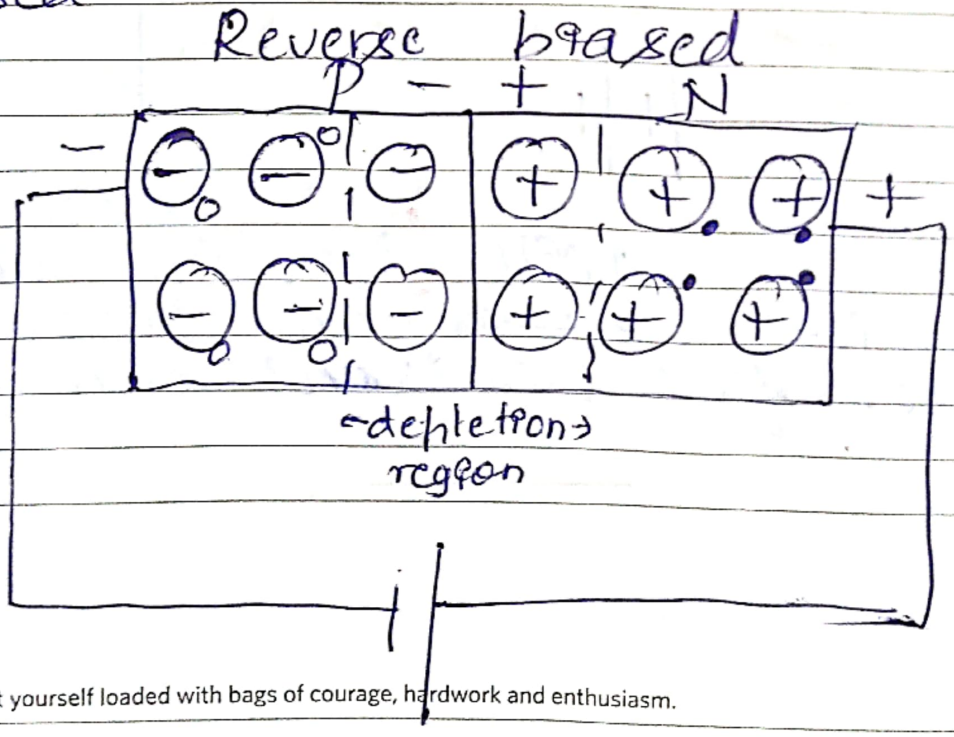
With forward voltage barrier reduces and hence holes free electrons can cross

13-elect-I
16-elect-2

the junction i.e. current flow can take place as the forward voltage is increased barrier decreases and when it exceeds the barrier potential the barrier is completely eliminated thus a forward biased diode allows current to flow through it and external circuit.

B

Suppose the P-type material is connected to the negative battery terminal and N side to the positive terminal as shown below, then the PN junction is said to reverse biased.



Whenever the ~~P-ty~~ P-side or the anode terminal of the diode is at a lower potential then N-side or cathode terminal then the diode is said to be reverse biased, here the reverse voltage simply increases the barrier and hence no current flows due to the majority charge carriers in both the regions, if reverse voltage is increased more there will still be no current through the diode. In other words a diode introduced in circuits allows current flow when it is forward biased and blocks the flow of current when it is reverse biased. A forward biased diode is said to be equivalent to a ~~is~~ closed switch and reverse biased diode equivalent to an open switch.

17 THURSDAY • MARCH • 2016

FEBRUARY 2016

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

DIODE

* A semiconductor device which has a single PN junction.

* It allows current when it is forward biased

* Absence of mobile carriers, holes and current carriers.

* ~~Function:-~~

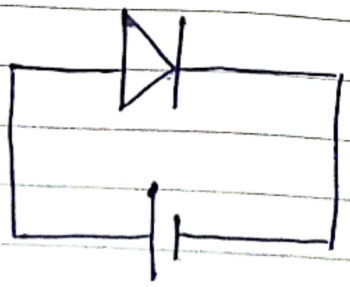
Forward biased

P type is connected to positive terminal and N type to negative terminal.

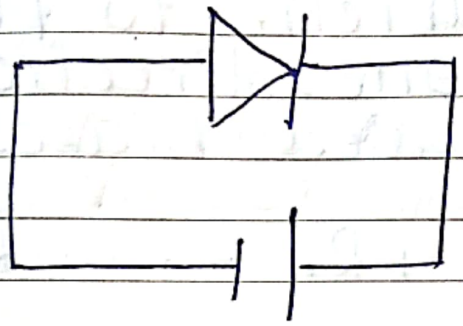
Reverse biased

P type is connected to negative terminal and N type to positive terminal.

Forward biased



Reverse biased



Explain diode: when it is just formed
when no external voltage is applied
Role played by depletion region

Behaviour of diode when voltage is applied to it.

Explanations should be with diagrams

Paper is easy
If any part not clear to you I dont want anyone to fail in this exam and score above 20.

(079-287) WK 12

19 SATURDAY • MARCH • 2016

FEBRUARY 2016

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

Important Property of a diode

Diode allows current to flow through it in one direction when it is forward biased

Series → $R_S = R_1 + R_2 + R_3 + R_4 \cdots R_n$

Parallel → $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \cdots \frac{1}{R_n}$

$V = IR$

$H = I^2RT$ $\quad P = I^2R$

$H = VIT$ $\quad P = VI$

$H = \frac{V^2T}{R}$ $\quad P = \frac{V^2}{R}$

(080-286) WK 12

20 SUNDAY Try to get the full marks on the paper.
I-card is very-very important.

ADVANCE HAPPY

Remain consistent in your work success will follow.

Adwait S. Surag

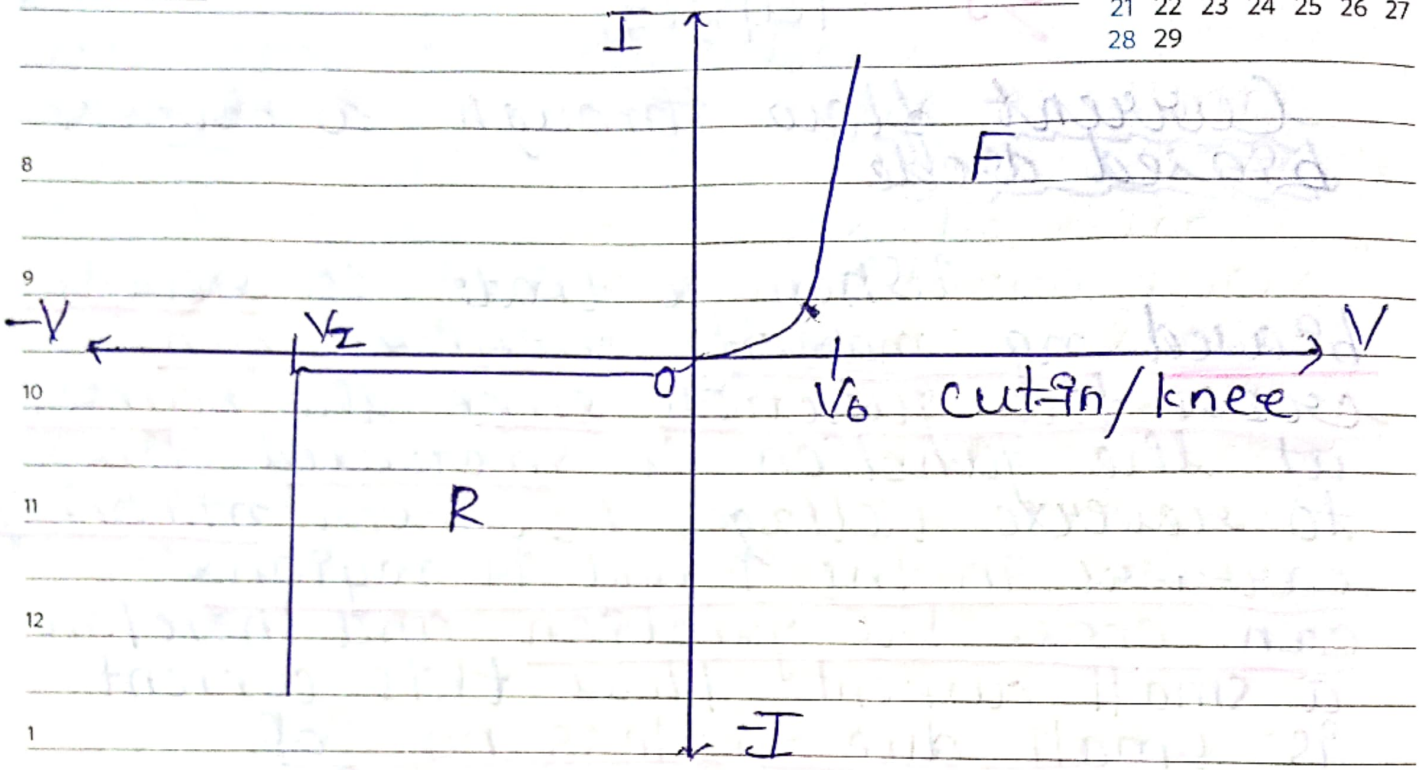
Paper II

Current flow through a reverse biased diode

When a diode is reverse biased ng majority carriers can cross the junction since the barrier at the junction is increased due to reverse voltage, however minority carriers in the P and N regions can cross the junction and therefore a small current flows this current is small due to less no. of minority carriers the no. of minority carriers depends on temperature and not on voltage hence, increase in reverse voltage will not increase this reverse current.

V-I characteristics of a diode

A wise man is one who can turn information into ideas.

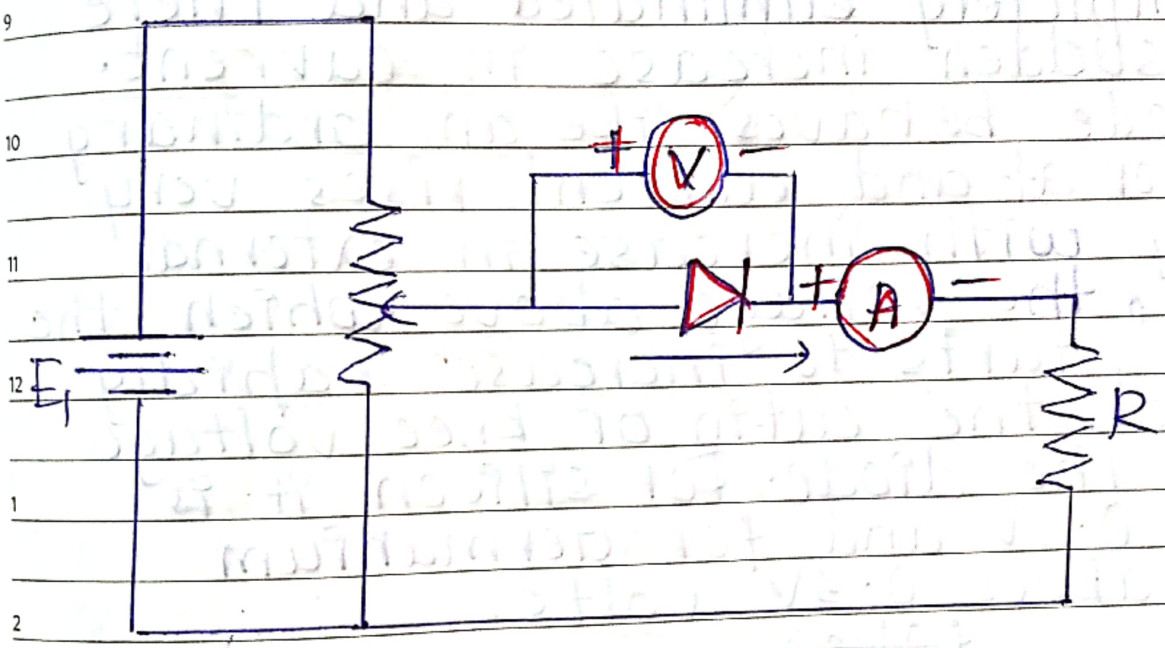


This is a graph bet^n voltage applied across the diode terminals and the current that flows through it. This characteristic tells us how much current flows for a particular value of diode voltage.

(1) FORWARD CHARACTERISTICS

This is the characteristic which is obtained when the

applied voltage forward biases the diode, to obtain this we make use of the foll. circuit.



Each value of diode voltage produces a particular current initially when the applied voltage takes value of 0.1 V or 0.2 V the diode current is very small the diode does not conduct well until the external voltage overcomes the barrier potential, therefore in the case of silicon

Keep your focus positive on family and career as well coz both has to move till end with.

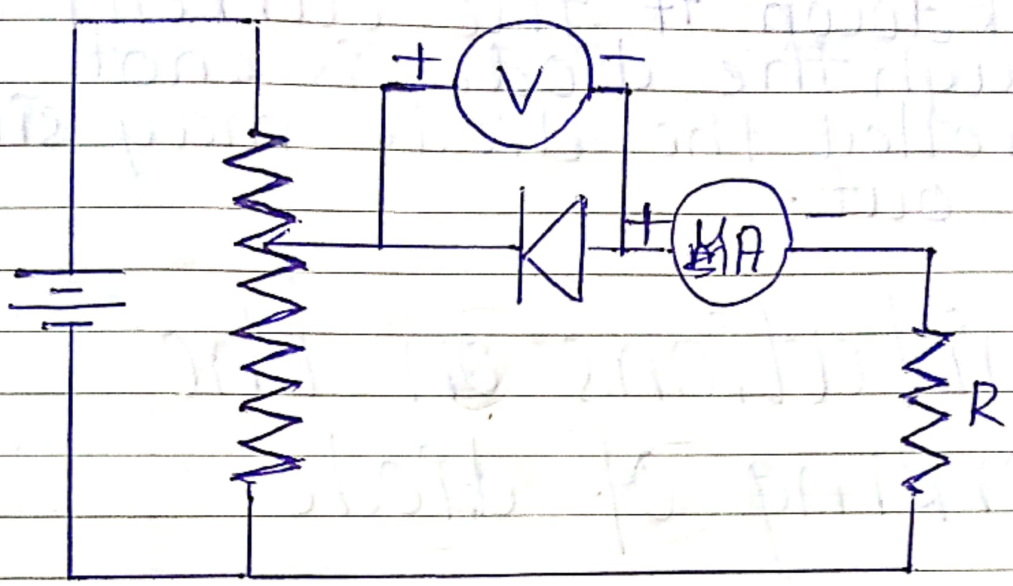
24 THURSDAY • MARCH • 2016

as we approach 0.7V a nq. of holes and free e⁻ start crossing the junction as the barrier is reduced, above 0.7V the barrier is completely eliminated and there is a sudden increase in current. The diode behaves like an ordinary conductor and current rises very sharply with increase in external voltage, the voltage above which the current starts to increase rapidly is called the cut-in or knee voltage (V_0) of the diode. For silicon it is above 0.7V and for Germanium it is above 0.3V volts.

Reverse Characteristic

when a diode is reverse biased the relation betn reverse voltage and resulting current is shown by the reverse characteristics, the follo circuit is used to plot the reverse characteristic.

Your level of thinking increases with growing experience not with growing age.



In the reverse biased condition as you increase the applied voltage the current remains small and constant for all voltages upto a certain limit because this current is due to the minority carriers which are thermally generated, when the voltage is made too high the current through the diode increases rapidly this voltage at which this phenomenon occurs is called the break down voltage

26 SATURDAY • MARCH • 2016

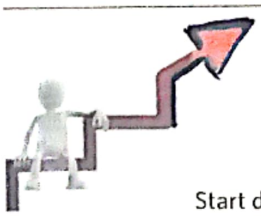
(V_z) of the diode, at breakdown if the current through the diode is not controlled the diode may simply burn out.

Limitations on the working of diode.

(i) Max. forward Current ($I_{F\,max}$)

If the current through a diode is very large excessive heat generated will destroy the diode hence the manufacturer of the diode specifies the max. current a diode can safely handle without any damage to it, when forward biased.

27 SUNDAY



Peak Inverse Voltage (PIV rating)

It is defined as the max. voltage that a diode can withstand when reverse biased before breakdown occurs.

Max. Power Rating

It is the max. power that a PN junction can withstand without causing damage to it

Application of diode

rectifier

29 TUESDAY • MARCH • 2016

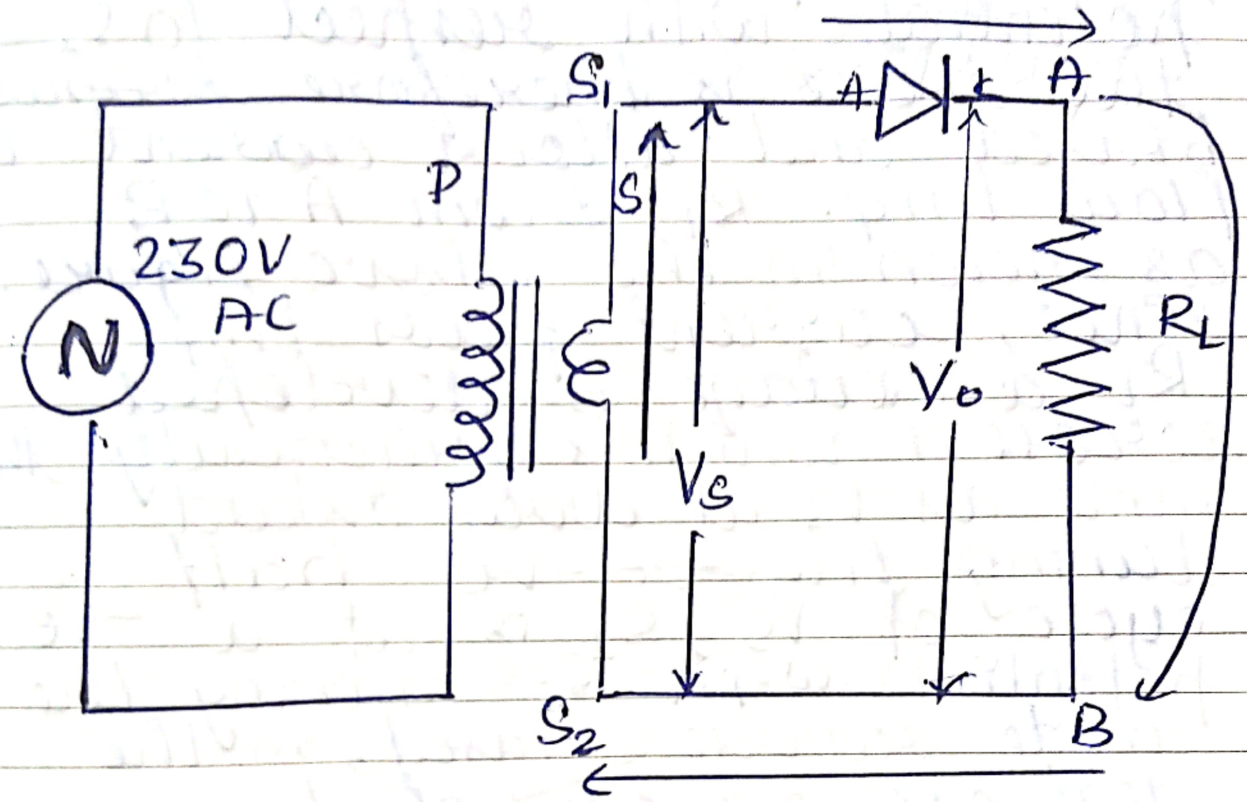
FEBRUARY 2016

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

Rectifiers are circuits which convert AC to DC due to its property of allowing current flow in only one direction it is possible to use a diode for converting AC to DC. There are 3 types of Rectifiers half wave, full wave and bridge rectifier. The circuit diagram of a half wave rectifier is shown below, it uses step-down transformer for converting the high AC mains voltage to a lower one. Diode is used as a the rectifier and the out-put is delivered to a load resistor R_L.

Half wave ~~rectfie~~ rectifier

Make a rigid plan for your success,
enormous flexibility sometimes makes you face failure.



230V AC is applied to the primary terminals of the transformer, the secondary terminals S_1 and S_2 are connected in series with the diode and the load R_L. The transformer secondary provides a voltage Vs to the rectifier. During the pos. half cycle of the secondary voltage Vs

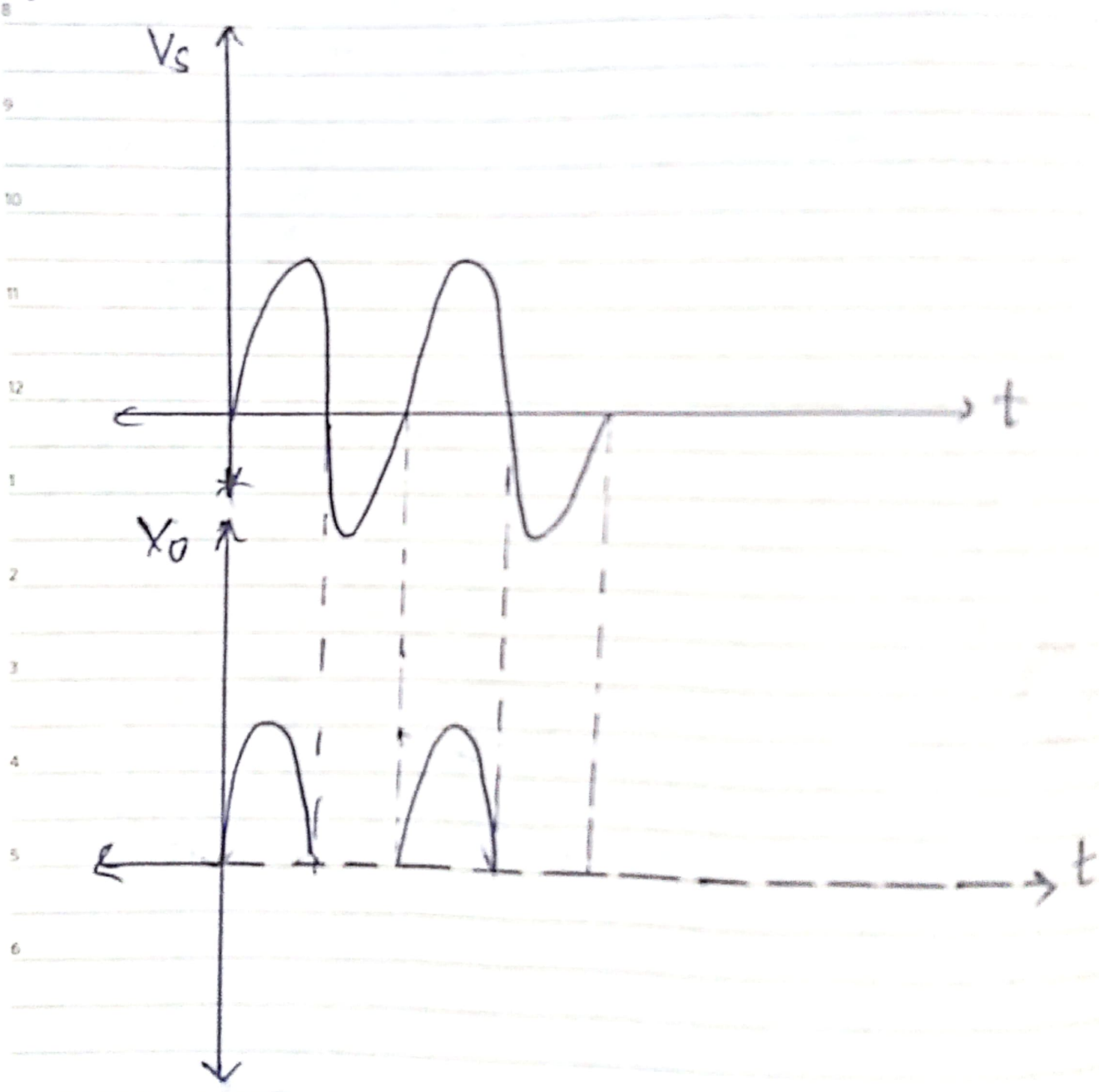
ADWAIT. S. PURAO

S_1 is at a positive potential with respect to S_2, the diode is therefore forward biased and allows current to flow thro. R_L from A to B as shown in the above figure. Hence, current flows thro. R_L a voltage is developed across it which is practically the same as Vs at every instant during the ~~-ve~~ -ve half cycle of Vs, S_1 is at a -ve potential w.r.t S_2 making the diode reverse biased, in the ideal case no current flows through the reverse biased diode and hence no current through R_L with output voltage equal to zero we can conclude that when Vs is going thro. its +ve half output Vo is also going through its positive half cycle but when Vs is in its negative half Vo remains ~~cont~~ constant at 0.

Discuss to generate ideas not to win arguments.

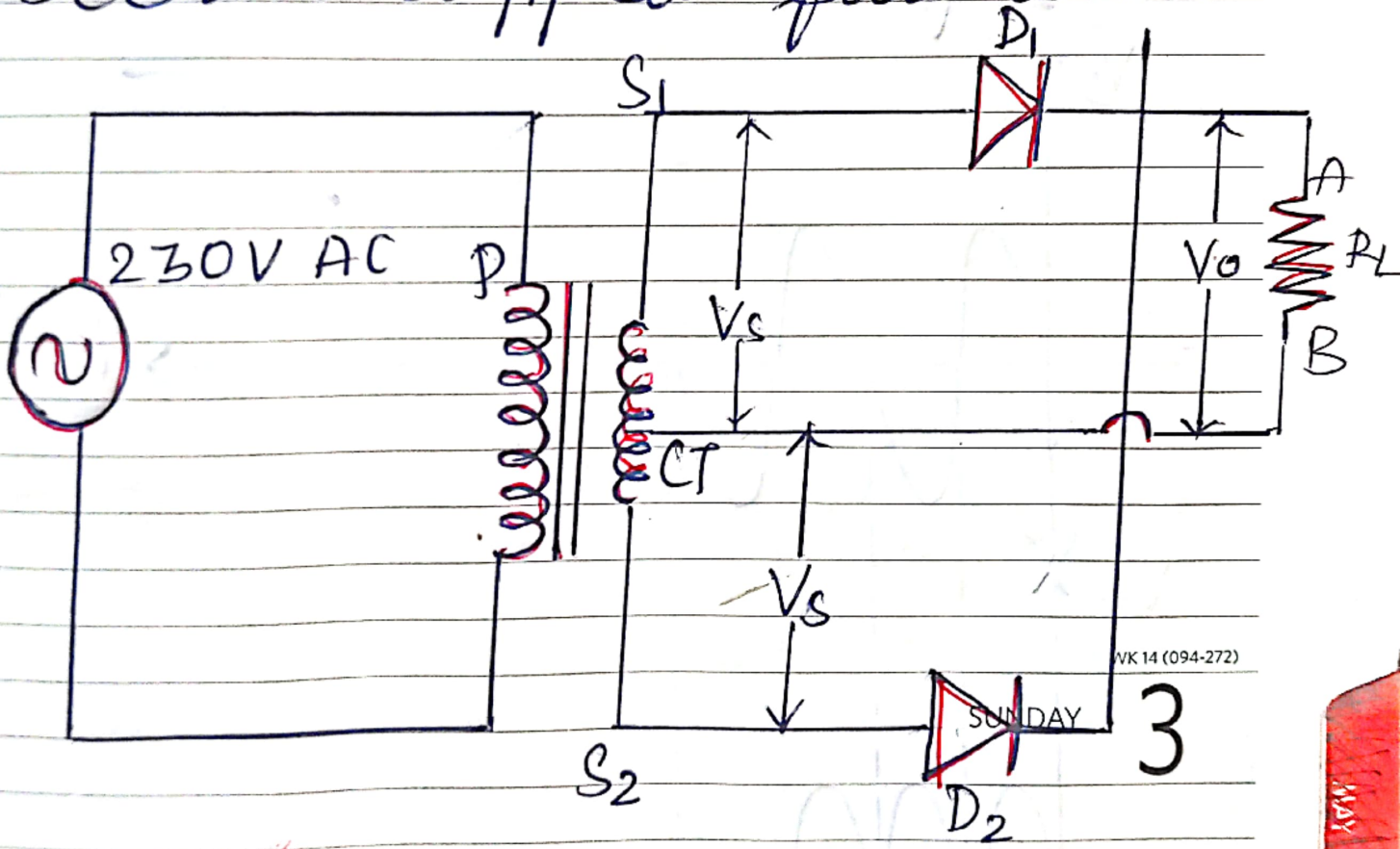
1 FRIDAY • APRIL • 2016

this is shown on the wave forms below:



Out put Vo changes in magnitude but is unidirectional hence we say that the output of the a rectifier is not a perfect DC.

Centre tapped full wave



A good leader is who takes his hands up in comitment on behalf of his team mates.

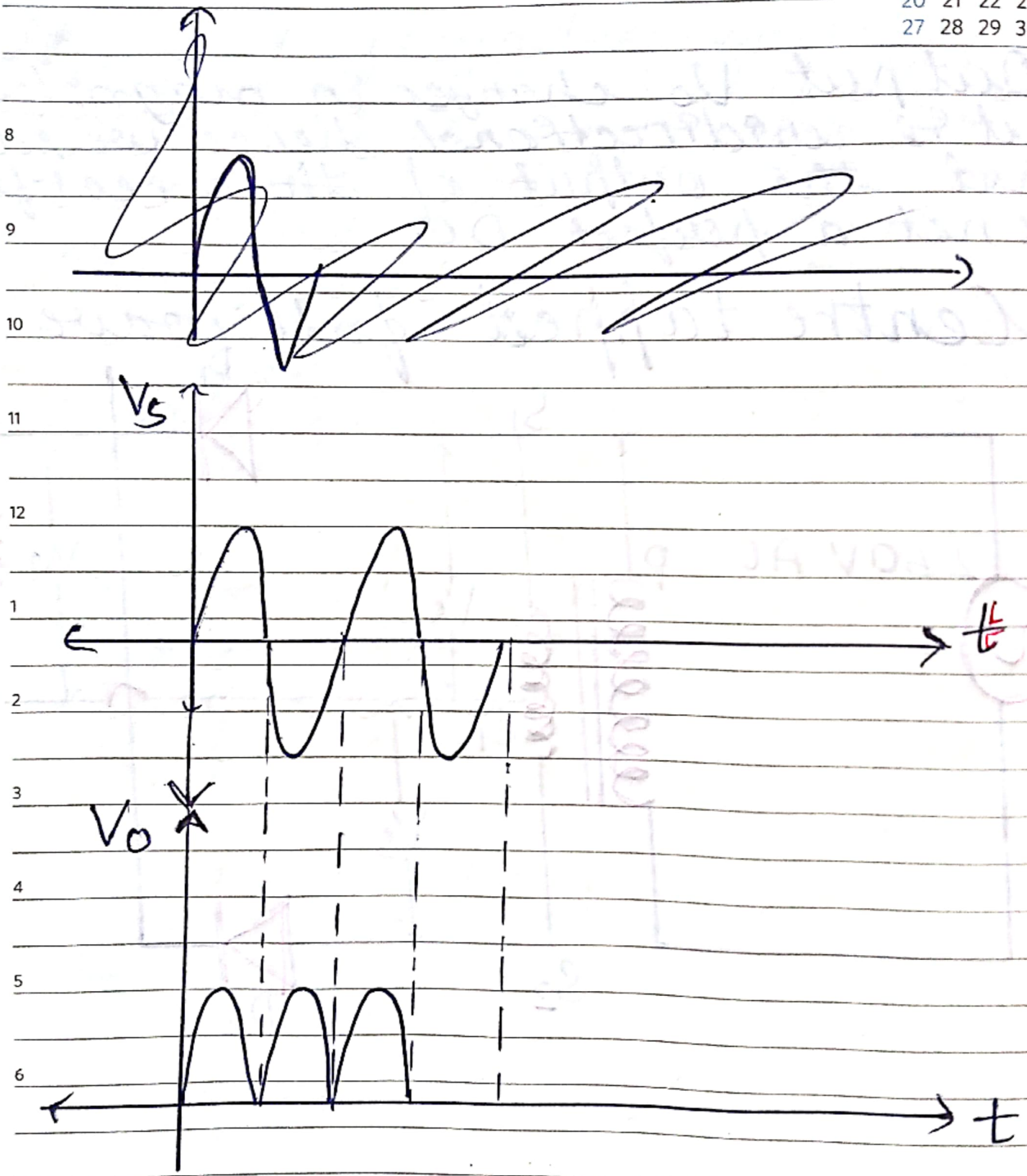
(095-271) WK 15

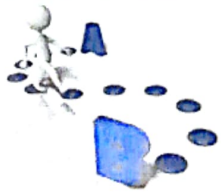
4

MONDAY • APRIL • 2016

MARCH 2016

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		





Achievement is not reaching from one point to other but overcoming all the obstacles coming in the way.

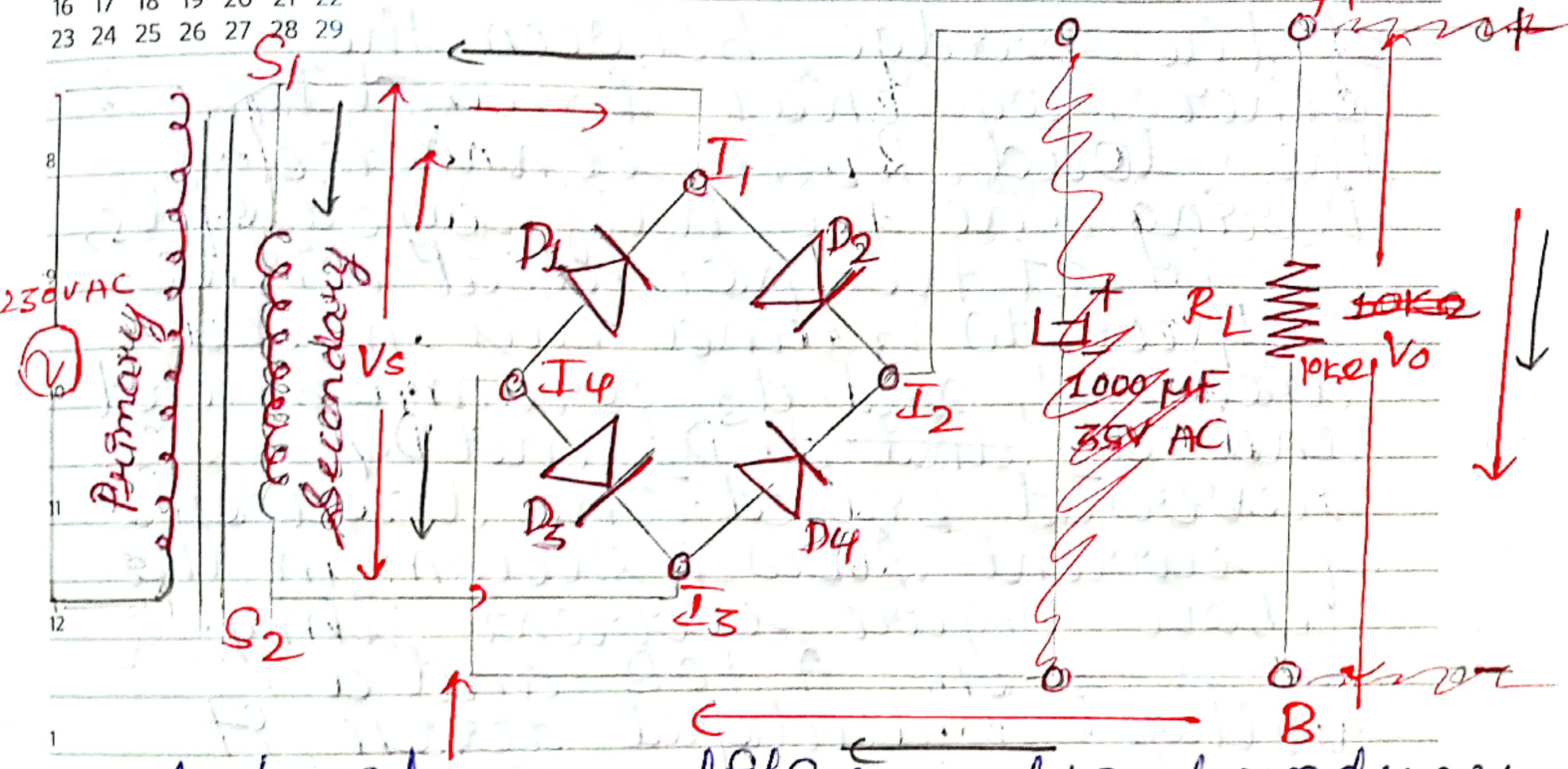
This circuit makes use of a centre-tapped transformer and two diodes D_1 and D_2 due to the centre-tap (CT) when S_1 terminal becomes positive w.r.t CT the other terminal S_2 becomes as much negative w.r.t. CT after half a cycle the position is reversed ~~V.S is~~ V_s is the secondary voltage of the transformer between terminals S_1 and CT, ~~and~~ S_2 and CT during the +ve half cycle of V_s, S_1 is at a +ve potential w.r.t CT and S_2 is at a -ve potential w.r.t CT, ∴ diode D_1 is forward biased and diode D_2 is reverse biased, current flows thro. D_1, load R_L from A to B and the upper half of the secondary winding, hence current flows thro. R_L a voltage is developed across it which is practically the same V_s at every instant. During the

Nothing you will get in comforts,
a plant has to face several calamities before turning to a tree.

negative half cycle of V_s S_1 is at a negative potential and S_2 is at a positive potential w.r.t CT hence D_1 is reverse biased and D_2 forward biased, current flows thro. D_2 load R_L from A to B and the lower half of the secondary winding, current flowing thro. R_L develops a voltage across it, which is almost the same as V_s at every instant, from the input output wave forms we observe that output changes in magnitude but is unidirectional, hence output of this rectifier is also not a perfect DC.

Bridge Rectifier

A true friend is one who unlocks your best qualities from which you are still unaware.



A bridge rectifier also produces full wave rectification It differs from a centre tap full wave rectifier into respects.
1) It uses four diodes and secondly it does not need centre tap transformer. 230 V A-C is applied to the primary terminals of the step down transformer The secondary voltage Vs is applied to the diagnally opposite ends I_1 and I_3 of

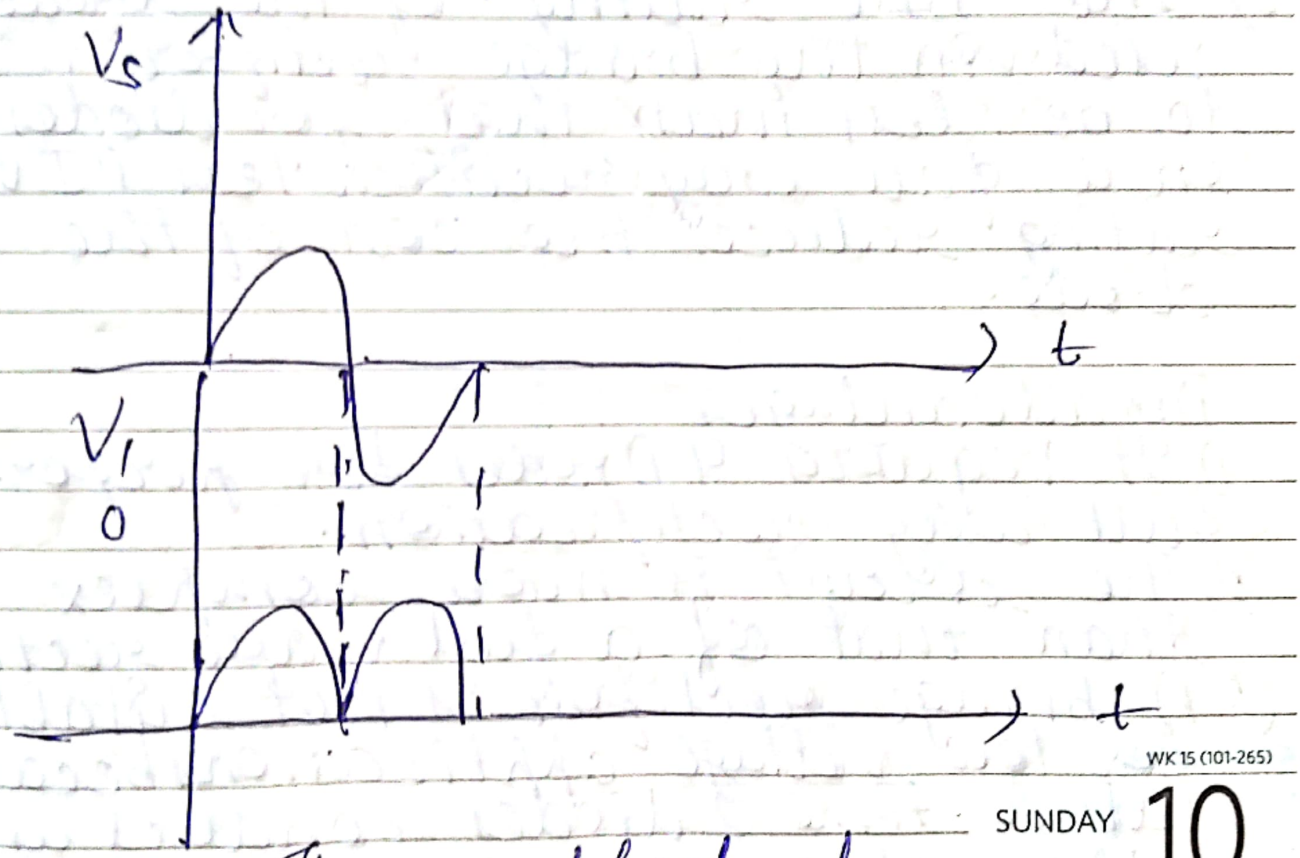
8 FRIDAY • APRIL • 2016

and
of the bridge between the other two ends T_2 and T_4 the load R_L is connected. During the +ve half cycle of V_s, T_1 is at +ve potential with respect to T_3 and this makes diodes d_1 and d_3 forward biased and ~~d_2 and d_4~~ D_2 and D_4 reversed biased. The direction of current flow is shown in the above figure, current thro. R_L is from A to B and a voltage is developed across it which is almost the same as V_s at every instant. During the -ve half cycle of V_s, T_1 is made -ve with respect to T_3 ... diodes D_1, D_3 are reversed biased while diodes D_2 and D_4 are forward biased, current flows along the path shown by pencil (→)

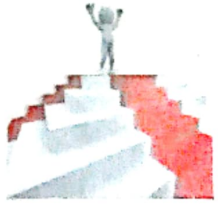
Current thro. R_L is

One who saves in the present, enjoys the future.

again in the same direction A to B and a voltage V_0 is developed across R_L which is practically the same as V_s at every instant. The input and output wave forms are shown below.



The output of a bridge rectifier is also not a perfect DC becoz because even though it is unidirectional it still changes in magnitude.



11 MONDAY • APRIL • 2016

MARCH 2016

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

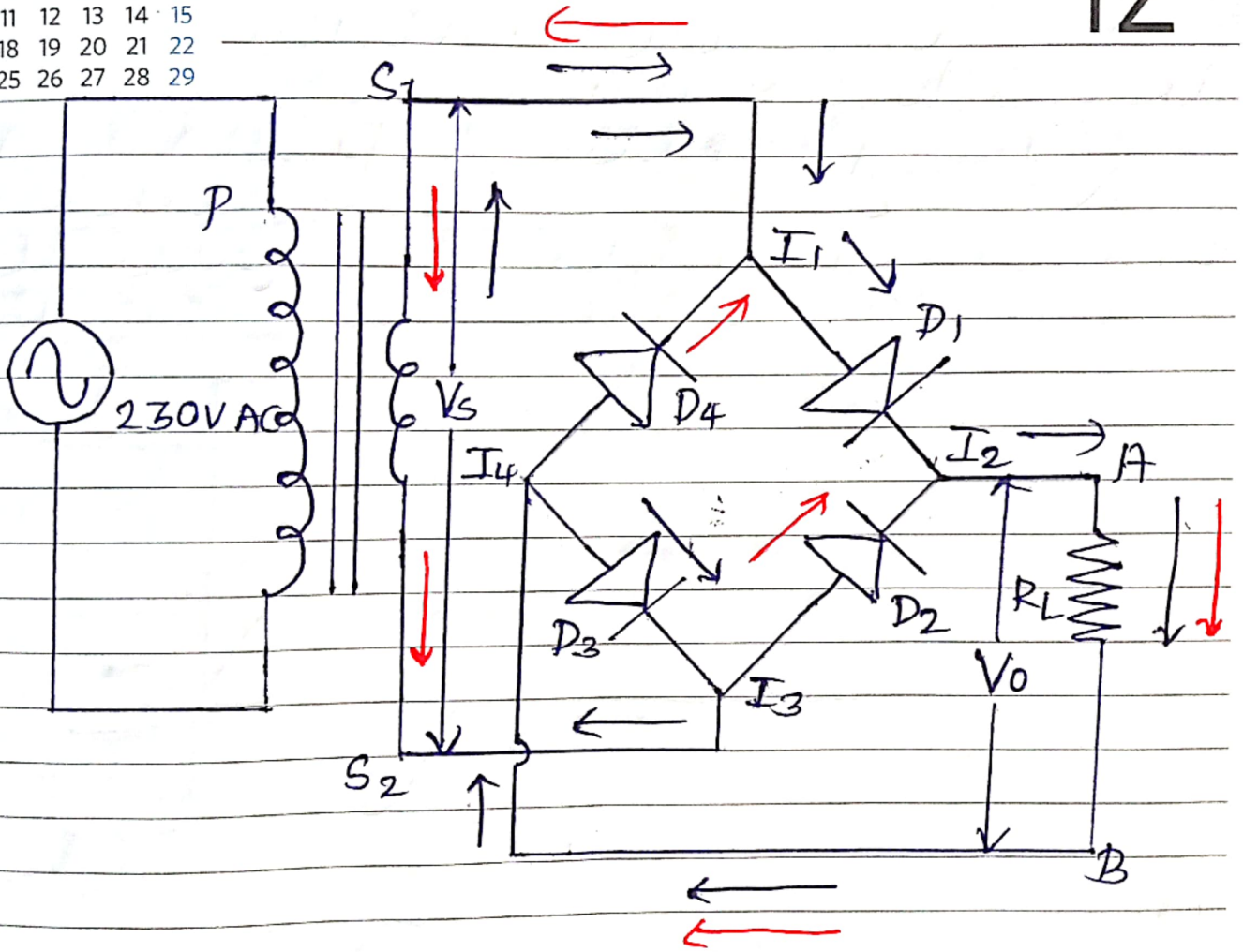
Advantages

1) It does not require centre tapped secondary winding for the transformer which is more costly.
2) The PIV rating of the diodes used in the bridge rectifier is to be less than that for diodes in a full way rectifier, less PIV rating reduces the cost of the diode.

Disadvantages

1) It requires 4 Diodes for performing full way rectification.
2) The circuit is more complex than that of a full wave rectifier.
3) A bridge rectifier is not suitable for low voltage applications because at a time, 2 diodes conduct and the voltage across them becomes significant.

Don't get confused with multiple tasks rather take them as options to grow.


S1
P
230V AC
Vs
I1
D1
D4
I4
I2
A
D2
D3
RL
I3
Vo
S2
B