Hello and welcome students.

To a module on FBSc Electronics,sem one ELC 101 subject code paper

title network analysis and analog electronics. Unit II junction diode and its applications

module name, regulation line and load regulation. Zener diode as

a voltage regulator module #19presented by Mr. Girish Abhyankar.

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Outline: will study introduction to voltage

regulator, line and load regulation and will study zener

Diode as a voltages regulator.

The student will be able to explain the voltage regulation,

explain the line and load regulation, and explain the

voltage regulator using zener

diode. So we have been seen in the last 2-3 modules the block

diagram of DC power supply, so we have studied transformer.

It's used to isolate the remaining circuits from the

mains. Rectifier will convert this AC into DC half wave or full wave.

Now the filter will actually smooth out these ripples. OK, an

voltage regulator is now supposed to regulate this

voltage. Regulators maintains it constant irrespective of the

changes in the voltages in the line we have seen in our

household. How would the line voltage fluctuates OK, all of us experience these fluctuations in the AC supply which is given by the Electricity Department.So even if this AC changes RMS value changes, it is our duty as a designer to maintain the output voltage to a constant within of course limits. And also if the load changes also we should be able to maintain a constant output or pulled is ideally we should get a voltage like this straight line parallel to the X Axis or the time axis OK.

So what is voltage regulation in an unregulated power supply the output voltage changes whenever supply voltage, input supply voltage or load resistance changes. It is never constant. So what is the aim of voltage regulator circuit is to reduce the output voltage variations to 0 or at least to a minimum possible value.

Maintaining a nearly constant output voltage when input voltage vary is the purpose of line regulation.

OK, line regulation when I say line It is to do with maintaining a constant output voltage, nearly constant voltage when input voltage changes. So line voltage changes. That is what we call and maintaining nearly constant output voltage. When loaded changes load varies is what is the load regulation. So line regulation can be defined as a percentage change in the output voltage from a given change for a given change in the input

voltage. So how much is input changed and how much Corresponding to that, how much is the output voltage change

OK, so line regulation is defined as a percentage change

in the output voltage for a given change in the input

voltage. Load regulation, it is the percentage change in the

output voltage from no load to full load. No load means 0

current will say OK. Open Circuit we full load means

maximum current will flow when they'll be minimum load load

resistance. OK so we have V noload minus V full load

divided by V full load into 100 in percentage. So what is the no

load? No load is open circuit output voltage and what is full

load full load output voltage.So if we say now that 10

Volt regulated power supply at the regulation of .005%, what do

you mean by that? It means that the DC output voltage will vary

within an envelope of .005% of10 volts. How much is that?

.005% means .005 per 100 * 10 So will get .0005 it is .5

millivolts OK if you multiply by three times you get point

0.5 mvolts. Hence the output voltage will vary by plus

or minus .25 millivolts.

plus or minus with respect to 10 volts, so ten volts plus

.25 milli volts or 10 volts minus .25 millivolts. OK so

instead of expressing the voltage regulation by .005% we

can express it by a figure plusminus .25 millivolts.

Let us look at the circuit of using Zener diode as a voltage

regulator. So here we have a simple circuit here. This is a

Vin is an unregulated supply which we get from the rectifier. We

have R and we have a zener diode here which is connected in

parallel across the load. OK so zener diode. Now it is connected.

See in the reverse bias.Remember anode is here and cathode is
 here. OK positive and

negative. So zener diode, when working in the breakdown region

can serve as a voltage regulator because we want zenerr to

operate in the reverse breakdown region. So voltage regulation

is a measure of the circuit ability to maintain almost

constant output. So in the figure shown V in the input

voltage variations are to be regulated. So we will say that

this is unregulated one and here we want it to be regulated. Zener

diode is connected in reverse bias condition occurs, we always

see it is plus and minus because it's a rectifier output,

it's only the First point is so positive and negative here. Then

only we can connect like this. if it is ulta way.

where only negative half cycle are being rectified. You

Connect diode in the reverse bias so so that it should come

reverse bias. So when the potential difference across the

Zener diode is more than Vz here, it conducts and draws

relatively large current students You can imagine the V-I

characteristics of the zener diode in reverse bias, so you

can see the straight line which is coming down in the

third quadrant of that graph OK.

So when the potential difference across the zener diode is

more than Vz. It conducts and draws will large current

through the series registers

are. The load resistance RL across which a constant.

Voltage is required is connected in parallel with the diode. Here

load resources. Here we want the voltage to, remain constant.

So what is the total current? I herev is IzI plus IL this

circuit restricts the output voltage variations within

reasonable limits around Vz. even if there is a change

in Vin or change in IL.

So let us see how the circuit maintains a constant output

voltage under conditions of

changing input. Or changing the load. So here we have line

regulation and here we have the load regulation. So let us see case one. Suppose RL is kept fixed. OK, RL is kept fixed

Means load is kept fixed means IL is fix in the given

scenario but if Vin increases slightly so V in is increasing RL

we're not changing, we're

keeping this fixed. Increasing Vin will increase the current I.

OK, now increase in I will be absorbed by the zener diode

keeping IL constant and since I L is constant IL into

RL Vout will remain constant. So Also we can say that increase in

Vin will be dropped across R. OK here so Vin V in is IR plus

Vz and Vz is nothing but Vout supposed to be because they

are in parallell. So therefore whatever we say. OK whatever we

say that whenever Vin increases the current increases.

That is dropped across this
IR . OK, suppose Vin

decreases. The zener diode takes a smaller current and IR drop is reduced so here IR drop is reduced to produce keeping Vout constant.

So thus when Vin changes I and IR drop changes so as to

keep Vout constant.

Case ii let us say we are changing RL so that IL is changing.

OK, and we are keeping input fix second case now if IL

increases why will IL increase?Suppose we are decreasing these

RL then IL will increase.

Now if IL increases that Zener will take lesser current.

Thereby keeping I constant. If I is constant IR is

constant, Vin we have kept constant and therefore output

voltage will always remain constant because output

Voltage is Here Vin minus IR.

OK, so since I remain constant and IR remain constant,

Vin is assumed to be fixed in this case and this is fixed.

This is constant and output should remain constant.
If IL decreases.

Now suppose I increase the RL,then IL will decrease if IL

decreases what will happens IZ increases keeping I

constant and since I is constant IR is constant, V in

constant or we have kept it fixed. Both these contitiess are

fixed.Therefore output also will remain fixed. This is the formula for R

we can derive. Vin OK minus Vout upon Iz plus IL

because I is IL plus Iz OK. Let us see some examples of

this particular circuit. Circuit shown here for the circuit

shown, calculate I IZ IL and how will these values be affected if

the source voltage increases to 60 volts. now it is 40 volts

right now if it is increased to 60 volts how will it get

affected and the maximum power for zener diode is .5 watts and

Zener resistance is neglected. So see here. When V in is 40 OK, VAB,

that is a Vz is 10 and therefore voltage across 3K is

40 -- 10. That is 30 volts.

And therefore, how much is I? It is 30 / 3 kiloohms is 3by 3,000.

Is 10 milliamps OK What will be the load current? 10 volts

divided by two K 10 volts divided by 2K that is .005

Amperes or five milliamps and therefore how much is the Iz

it is total current minus the current in the IL it is 10 -- 5

five milliamps. OK now is it OKthat 5 mA is OK or is it

going beyond the limit of the Diode? See What is the maximum

power of diode given is .5watts that is Vz into Iz max.

so .5 is given Vz is10. It is given to us and Iz

Max therefore we can calculate is 50 how much Iz it is

5 mA so it is way in the current range of the diode.

OK, now what happens when the V.60 So when V is 60? How much is

the voltage across 3 K 60 --10? It is 50 and therefore the

current is 16.67. This current is increased you see.. Now I L is 5mA

because it is 10 by 2K and therefore the remaining current

is the absorbed by the zener diode. It is 11.67. What was the

current in the zener diode previously it was 5mA. See

now it has gone to 11.67milliamps. Let us look at the final example and before concluding this, Assuming the zener the ideal zener diode then

Find the current in the circuit

shown here when RL is 20 kilo 5Kand 2K. So let us take the first

case. RL is 20K VAB orVZ is given to be 20 volts and

therefore the drop across 2K is 60 -- 20 = 40 and therefore I is 20

Milliamps what is IL now VAB by RL VAB is 20 20/ 20 kilo because we have taken

20 kiloohms 1mA and therefore how much zero diode current is

there? 19 because 20 -- 1 is 19.

Case two, let us make R 5K. All Other calculations will remain

the same. I will be again 20 because V is 60 -- 20 and now

look at I L V by RL 20 by 5 kiloohms 4mA and how much is this

Zener diode now? Current 16milliamps reduced since IL
increases Iz reduces and the last case here are able to 2K

again will have 20 miliamps and now see what happens to IL is 10

milliamps and therefore Iz takes 10 -- 20 -- 10 is 10

milliamps. So if you go on

increasing. Or decreasing RL a point will come well, Iz

will become zero or littleless and the zener diode will come out

of the reverse saturation. OK,out of the breakdown and then no

More this will regulate. OK so these are the two examples we

have seen to and make our understanding of the zener

diode as a voltage regulator more profound. The references used while preparing this material was according to this

textbook. Thank you very much.