

Micro Hydro Power Plant

LECTURE 9 : TYPES OF ELECTRONIC LOAD CONTROLLER

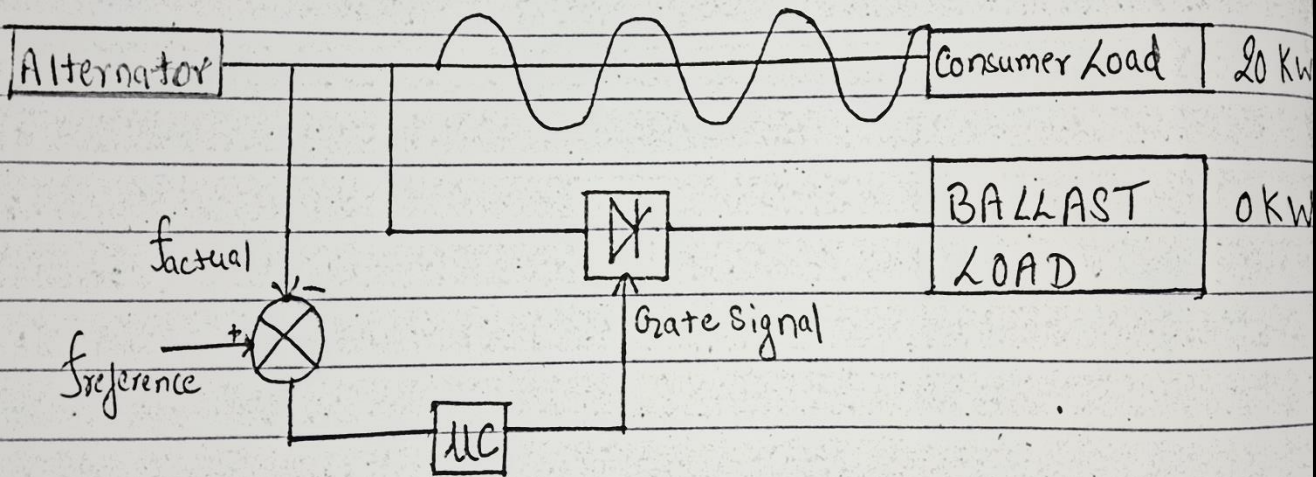
AC voltage controller based ELC

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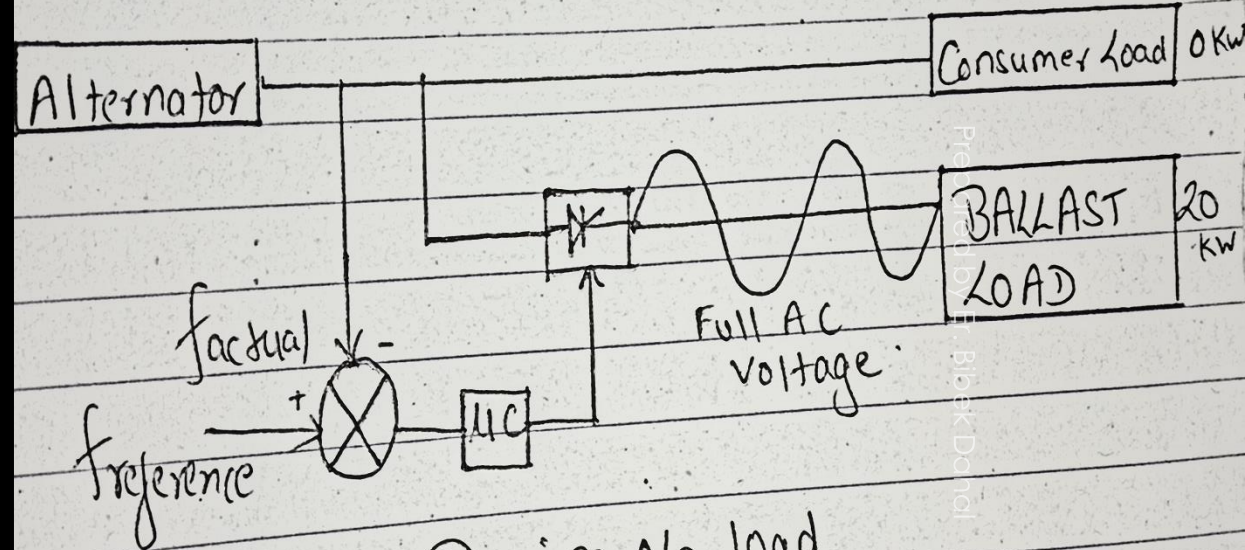
- ▶ In this type of ELC, thyristors are used as switches to divert the flow towards ballast loads
- ▶ Whenever the consumer load is maximum, the thyristors are switched off and the ballast load doesn't receive any power
- ▶ As the consumer load starts decreasing the thyristors are switched on with certain firing angle ' α ' and a chopped voltage is established across the ballast load and surplus power is dissipated in the ballast load in the form of heat
- ▶ Whenever the consumer load is disconnected (i.e. no load) the thyristor are fully conducting and the ballast load receives the entire supply from the generator

AC voltage controller based ELC

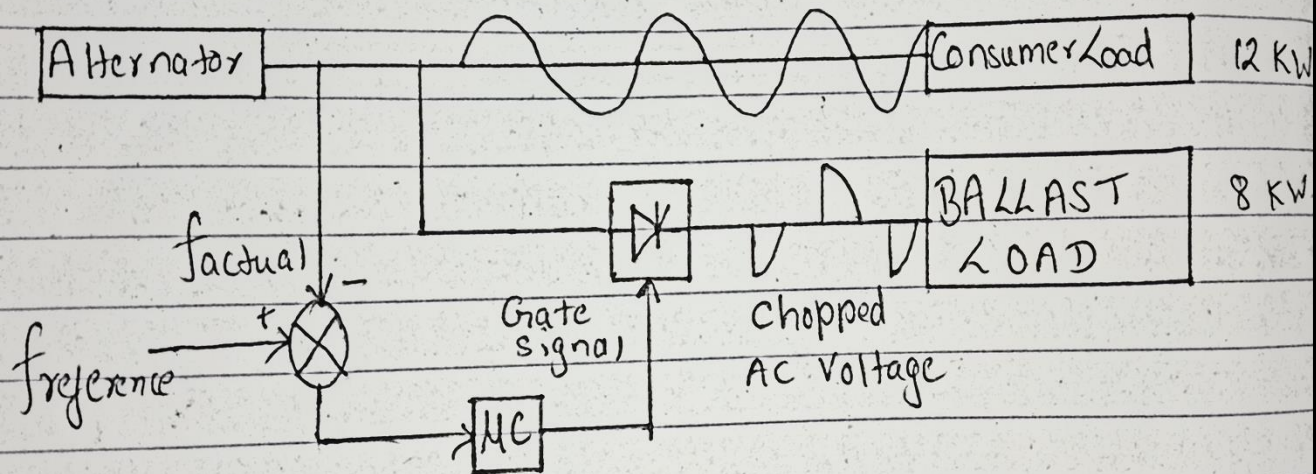
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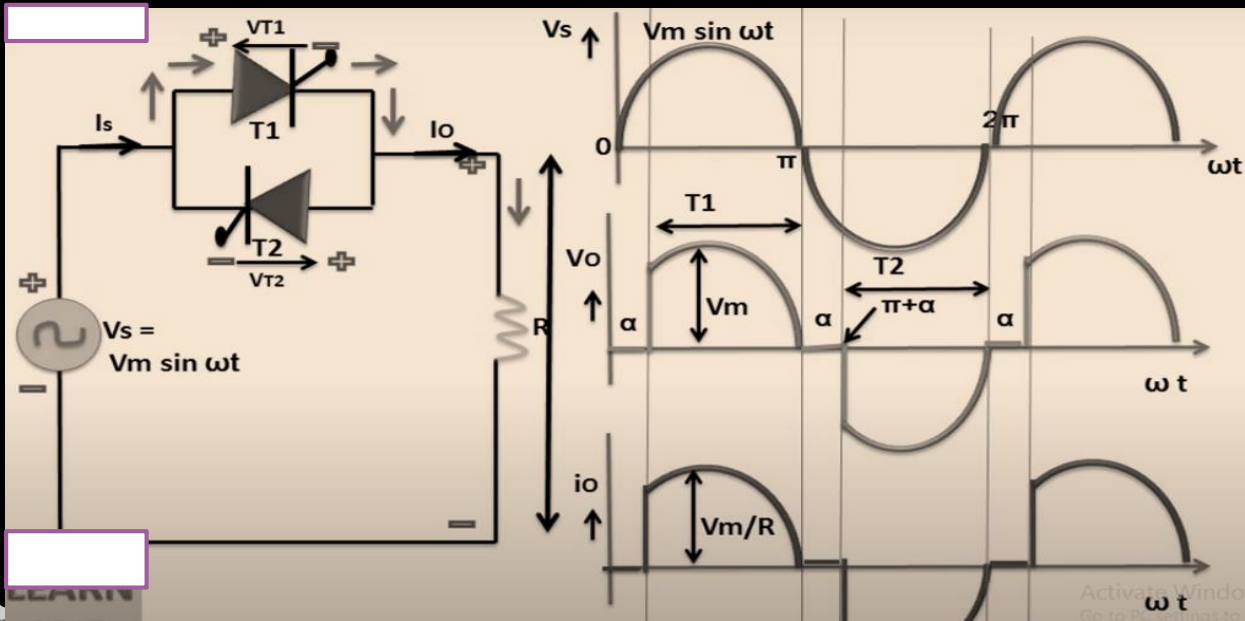
When Consumer Load is Maximum



During No load



When Consumer Load Decreases.



DC chopper Based ELC

- ▶ In this type of ELC, a combination of rectifier and chopper is used
- ▶ The power delivered to the ballast load is varied by varying the duty cycle of the chopper
- ▶ As shown in the figure, the three phase supply is fed to a three phase rectifier
- ▶ The output of the rectifier is fed to the step down chopper
- ▶ The voltage across the ballast load can be varied by adjusting the duty cycle of the chopper

DC chopper Based ELC

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Prepared by

DC Choppers

Circuit Analysis

Step Down Chopper with Resistive Load (Buck Converter)

RMS value of output voltage: $V_o = \sqrt{\frac{1}{T} \int_0^{t_{on}} v_o^2 dt}$

But during t_{ON} , $v_o = V$

Therefore RMS output voltage

$$V_o = \sqrt{\frac{1}{T} \int_0^{t_{on}} V^2 dt}$$

$$V_o = \sqrt{\frac{V^2}{T} t_{ON}} = \sqrt{\frac{t_{ON}}{T}} \cdot V$$

$$V_o = \sqrt{d} \cdot V$$

Output power $P_o = V_o I_o$

But $I_o = \frac{V_o}{R}$

∴ Output power

$$P_o = \frac{V_o^2}{R}$$

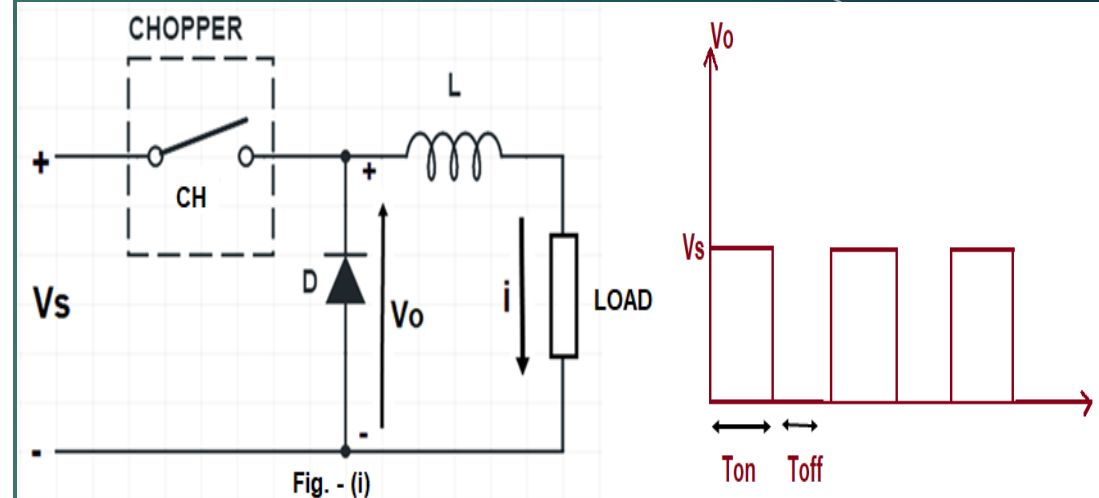
Power loss
in dummy
load =

$$P_o = \frac{dV^2}{R}$$

Operation of chopper

When chopper is on, $V_o = V_{dc}$

When chopper is off, $V_o = 0$



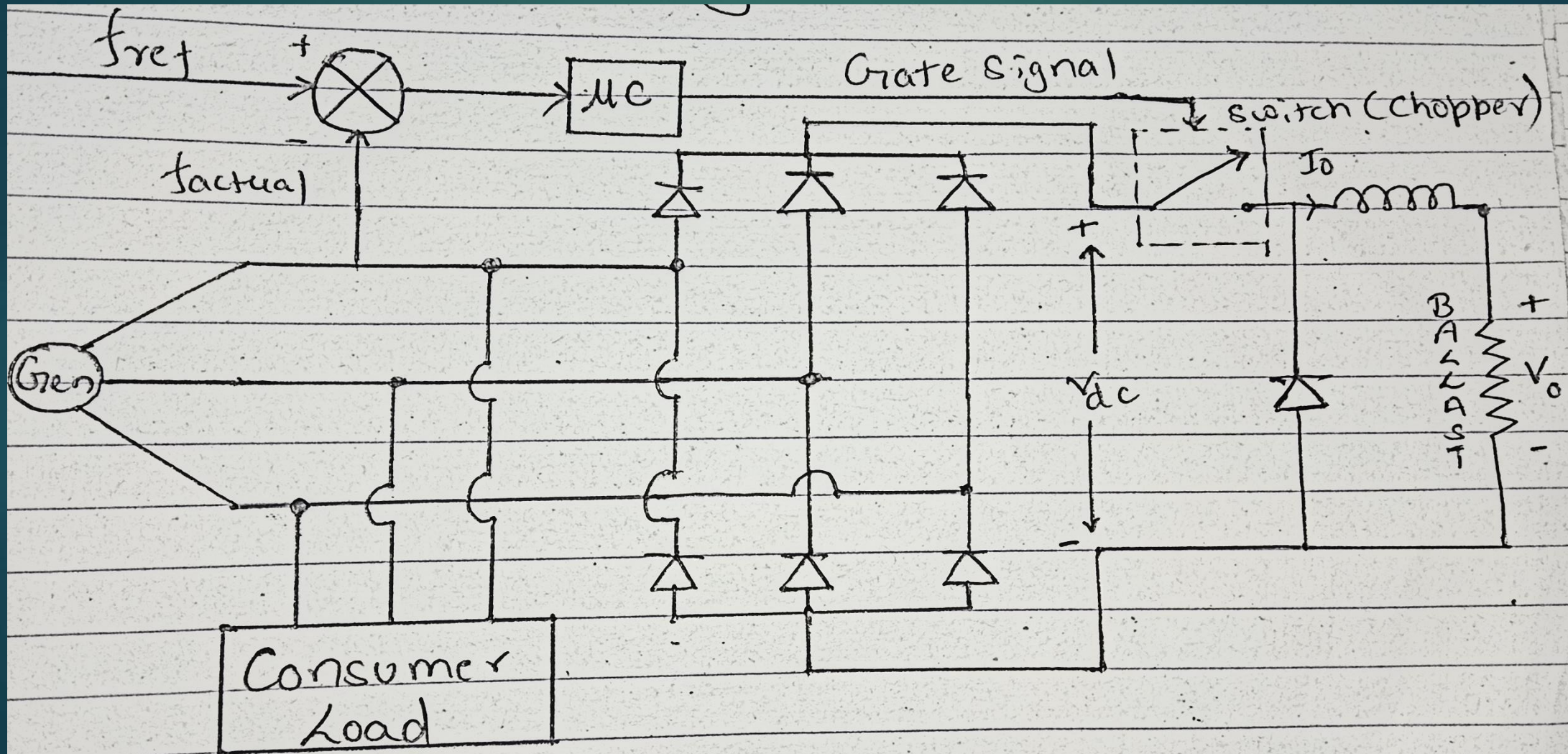
If $d=0$, the ballast load consumes no power

If $d=1$ the ballast load consumes entire power

Note: $0 \leq d \leq 1$

DC chopper Based ELC

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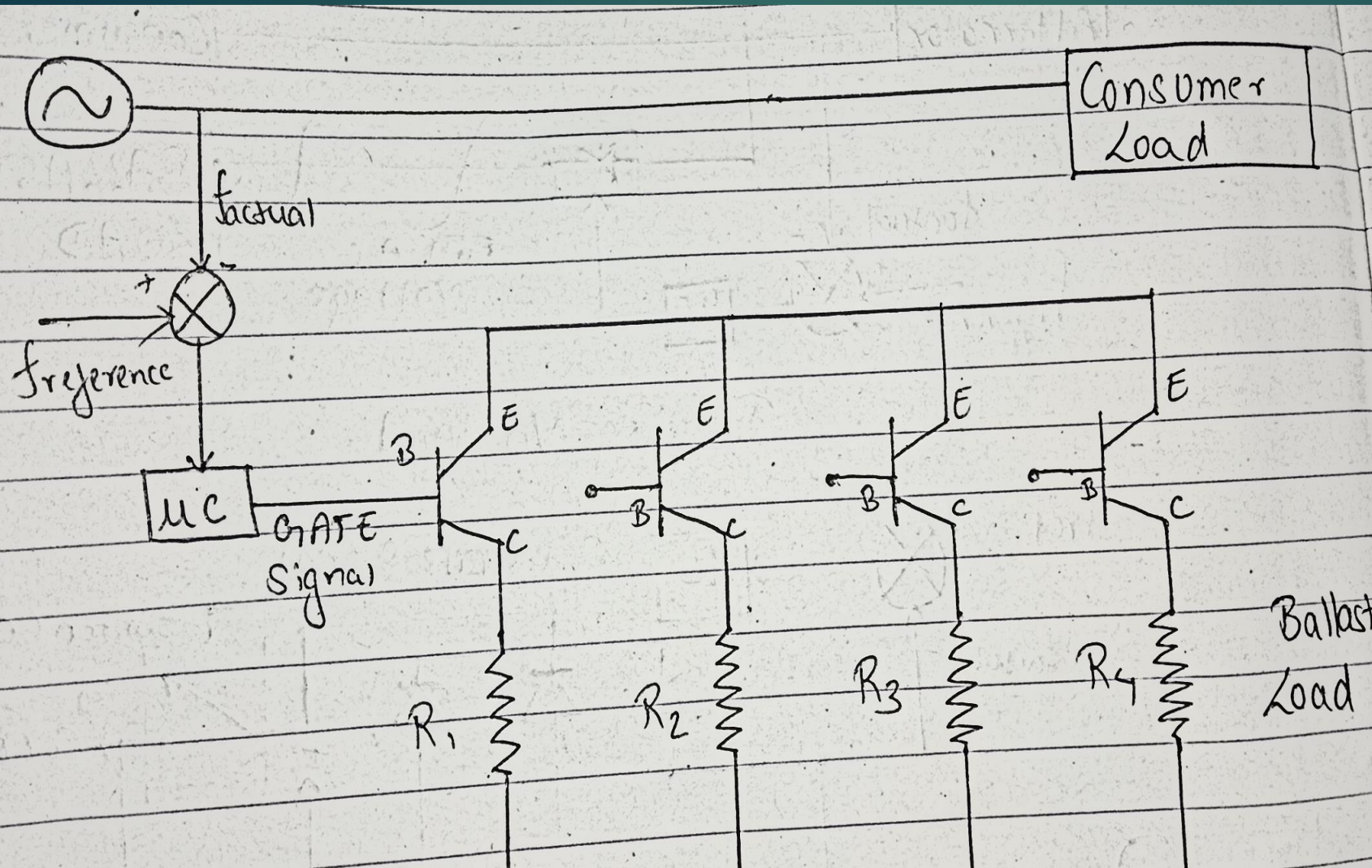
Discrete resistance type ELC

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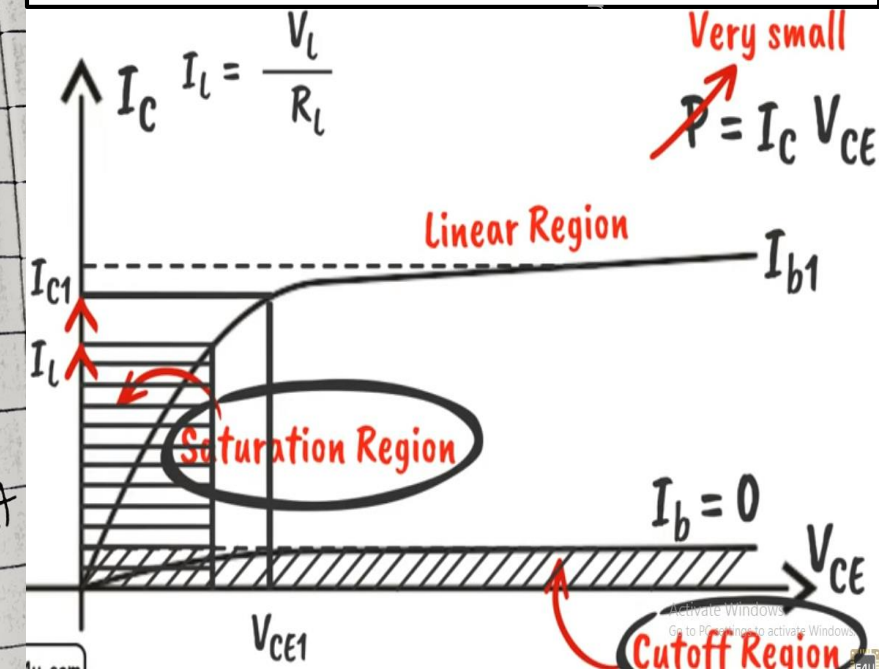
- ▶ In this type of ELC, transistors are used as switches to divert the flow towards the ballast load
- ▶ Whenever the consumer load is maximum, the transistors are turned off and the ballast load doesn't receive any power
- ▶ As the consumer load starts decreasing, the transistors are switched on by giving base voltage
- ▶ Thus surplus power is dissipated in the ballast load in the form of heat
- ▶ Whenever the consumer load is disconnected (i.e. no load) the transistor are all turned on
- ▶ This leads to the condition where ballast load receives the entire supply from generator
- ▶ This type of ELC turn on or off the discrete resistance bank rather than chopping the voltage across the dummy load
- ▶ The major drawbacks of this ELC are the requirement of discrete size of dummy loads , large number of dummy loads and the high cost associated with them

Discrete resistance type ELC

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Transistor as Switch



Thank You