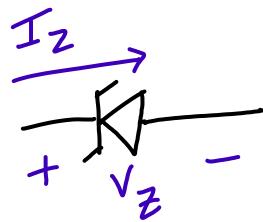
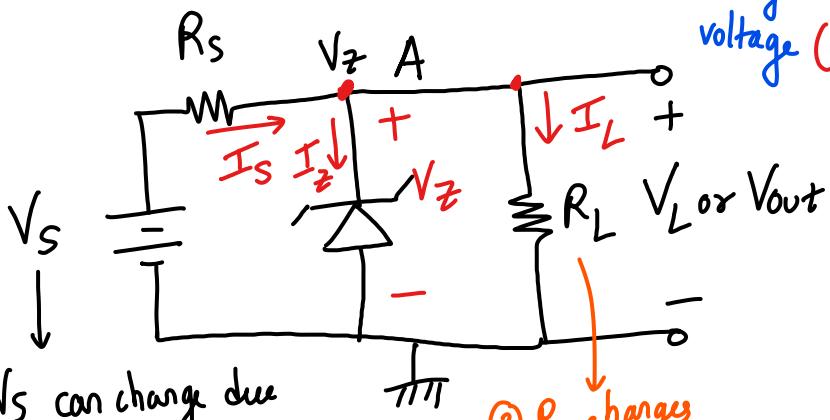


## \* Zener diode as voltage regulator (Application of zener diode)



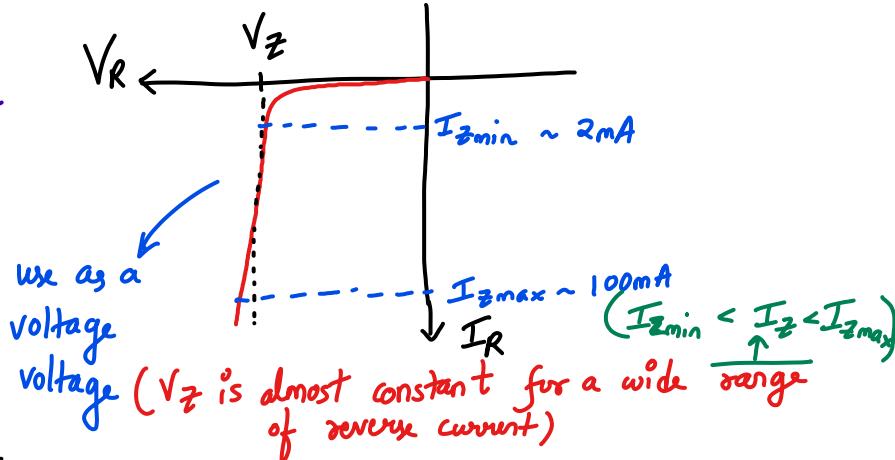
Zener diode symbol

$V_Z$  - breakdown voltage



①  $V_s$  can change due to line variations

②  $R_L$  changes



$I_L$  - load current

$V_L$  - load voltage

$V_Z$  - Zener voltage

$I_z$  - Zener current

"Voltage Regulator"

$$\rightarrow I_s = I_z + I_L \quad \text{①} \quad (\text{KCL at node A}) \quad \text{Aim: Keep } V_L \text{ or } V_{\text{out}} \text{ constant irrespective of Line & load variation}$$

$$\rightarrow R_s = \frac{V_s - V_Z}{I_s} = \frac{V_s - V_Z}{I_z + I_L} \quad \text{②}$$

$$I_L = \frac{V_Z \text{ or } V_L}{R_L}$$

$$; I_z + I_L = \frac{V_s - V_Z}{R_s}$$

$$I_z = \frac{V_s - V_Z}{R_s} - I_L \quad \text{③}$$

→ For proper operation,

- ① Keep  $V_s > V_Z \rightarrow$  Zener operates in breakdown mode
- ② Keep  $I_z < I_{z\max}$

variables:  $I_L$ ,  $V_s$ , constant:  $V_Z$ ,  $R_s$   
 "load variation"      "line variation"

① **Source/Line variation:** (If  $V_s$  changes,  $R_L$  is constant)

a)  $V_s \uparrow \rightarrow I_s \uparrow \rightarrow I_s = I_z + I_L \uparrow \rightarrow I_z \uparrow \rightarrow V_Z \text{ remains constant i.e. } V_L \text{ constant i.e. o/p voltage is regulated}$

b)  $V_s \downarrow \rightarrow I_s \downarrow \rightarrow I_s = I_z + I_L \downarrow \rightarrow I_z \downarrow \rightarrow V_Z \text{ constant} \rightarrow V_L \text{ constant i.e. o/p voltage is regulated}$

Note: In exam, use full sentences

- ② Load variation: ( If  $R_L$  changes,  $V_S$  constant )  $\rightarrow I_S$  constant
- a) If  $R_L \uparrow \rightarrow I_L \downarrow \rightarrow I_S = I_Z + I_L \downarrow \rightarrow I_Z \uparrow \rightarrow V_Z$  constant  
ie  $V_L$  constant ie o/p is regulated
- b) If  $R_L \downarrow \rightarrow I_L \uparrow \rightarrow I_S = I_Z + I_L \uparrow \rightarrow I_Z \downarrow \rightarrow V_Z$  constant  
ie  $V_L$  constant ie o/p is regulated

- ③ This is how, zener diode works as a voltage regulator

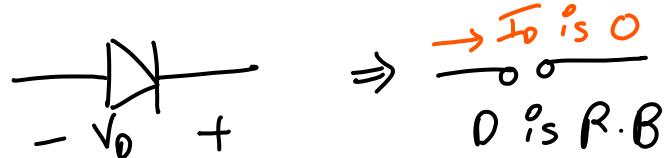
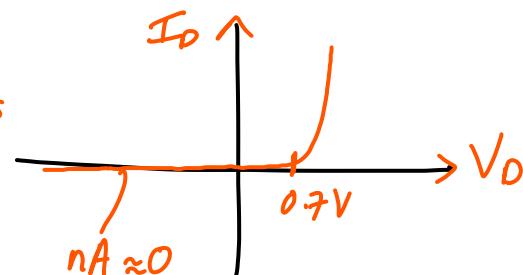
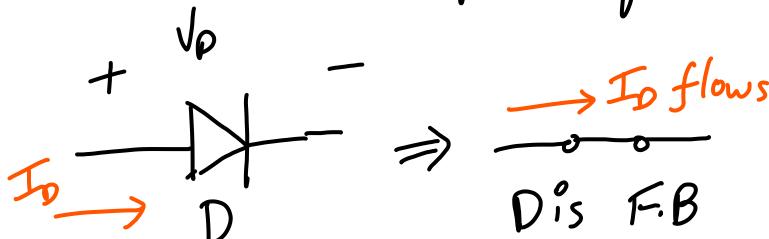
### Module 2.1 : Rectifier (Application of diode)



only with 'R' load

+ Filters (RC filter)  
Capacitor filter

- Parameters
- ① Ripple factor
  - ② Rectification efficiency
  - ③ TOF (Transformer utilization factor)



D: PN Junction diode









