Refer Razavi electronic 1 , Lec 6 : For topic on diode models and observations

(start video from 6 minutes 30 sec and watch it till 35 minutes)

Refer Razavi electronic 1 , Lec 6 : For topic on Clipper circuits

(start video from 47 minutes 40 sec and watch it till 63 minutes 33 sec)

Refer Razavi electronic 1 , Lec 7 : For topic on Application of Diode

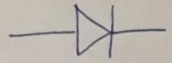
(start video from 11 minutes 25 sec and watch it till 25 minutes 33 sec)

Clipper circuits which we studied in class is CLIPPER 7.

In the below clipper circuits (from clipper 1 to 13), only using ideal diode model the waveforms are shown.

For Analysis of any clipper circuit, always perform the analysis in the manner it was done in class today i.e 21-07-2017 i.e (1st draw Vin Vs Vout , then the Output waveforms i.e Vout (t) / Vin (t) Vs time)

"Diode Applications"



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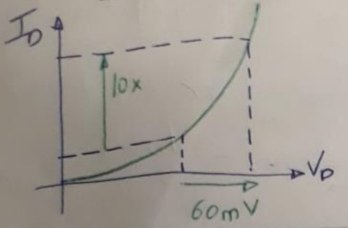
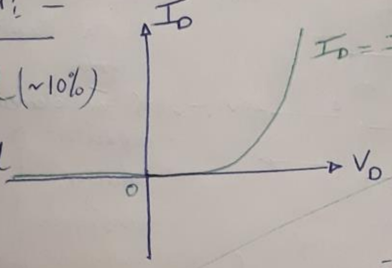


- Typ F.B vtgs for diodes are in the range of 700–800mV

$$I_D = I_S\left(\exp\left[\frac{V_D}{V_T}\right]\right) \qquad V_D = V_T \ln\left(\frac{I_D}{I_S}\right)$$

Modeling of pn-Junctn. –

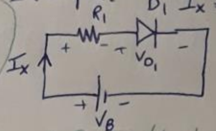
1) Exponential model (~10%)



$$I_D = I_S \exp\left(\frac{V_D}{V_T}\right)$$

- quite an accurate model if I_S is known
- It' nice
- doesn't satisfy ohm's law
- expn relatn betn I_D & V_D when F.B
- It possess lot of computatn effort.

Example:- $I_X = ?$



- Assume D_1 is F.B (good educated guess)
- Don't Panic

KVL,

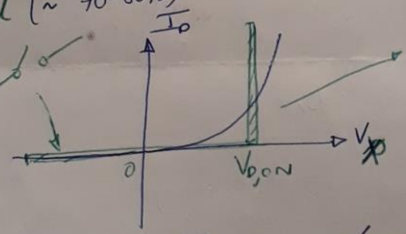
$-V_B + I_X R_1 + V_{D_1} = 0$

$-V_B + I_X R_1 + V_T \ln\frac{I_X}{I_S} = 0$ --- solve by iterat

- eqn's Not easy to solve!

② Constant-voltage model (~ 70–80%)

- not at all bad approximatn
- simplifies calculatns significantly.

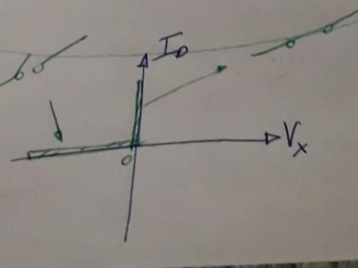


$V_{D,ON} \sim 700\text{-}800\text{mV}$ → good enough

- If $V_x < V_{D,ON}$ ⇒ Diode is off ≡ open ckt
- If V_x wants to exceed $V_{D,ON}$ ⇒ Diode is ON ≡ (short ckt with a battery) $V_{D,ON}$

③ Ideal Diode model: (~ 5-10%)

- Assumes $V_{D,ON} = 0$
- simpler than const vtg model
- "passes" +ve vtgs "Blocks" -ve vtgs



Diodes are interesting devices → becoz they distinguish betn +ve & -ve voltages

Clippers

1

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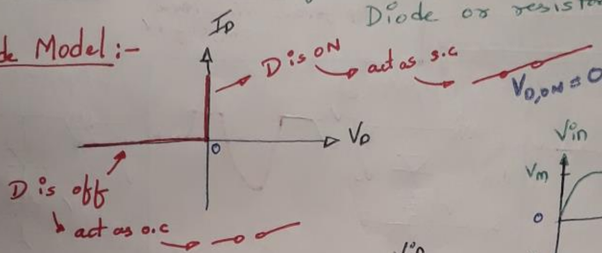
- +ve clippers] Biased clippers }
- -ve clippers
- series clippers }
- parallel clippers
- Combinational clipper

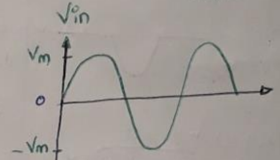
• Series/Parallel clipper - Diode acts as a series/parallel switch between the source and the Load.

• Biased clipper - has a provision for adjustment of clipping level (a bias vtg in series with Diode or resistor)

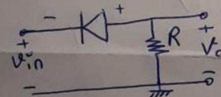
- Ideal Diode Model :-

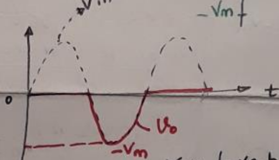


$V_{in} = V_m \sin \omega t$



Clipper 1:

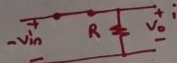




Negative Series clipper

• +ve h.c → D is OFF → ie (o.c) → $V_o = 0$

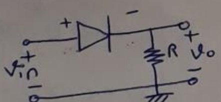
• -ve h.c → D is ON → ie (s.c) → $V_o = -V_{in}$ ie o/p follows I/p in -ve h.c

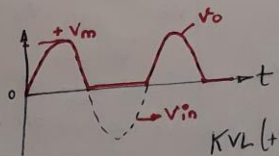


KVL (-ve h.c) : $-V_{in} + V_D - V_o = 0$

$V_o = -V_{in}$

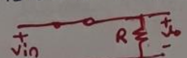
Clipper 2:





Positive Series clipper

• +ve h.c → D is ON ⇒ (s.c) → $V_o = V_{in}$



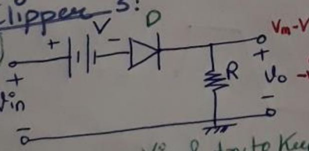
ie o/p follows I/p in +ve h.c

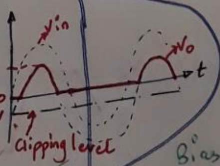
KVL (+ve h.c): $V_{in} - V_D - V_o = 0$

$V_o = V_{in}$

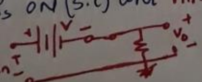
Clipper 3:

Biased series +ve clipper





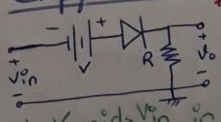
- Bias vtg V opposes V_{in} & try to Keep D off
- D is ON when $V_{in} > V$ & off for anything less.
- V_{in} (-ve h.c) :- D is OFF (o.c) → $V_o = 0$
- V_{in} (+ve h.c) :- D is ON (s.c) when $V_{in} > V$ in +ve h.c

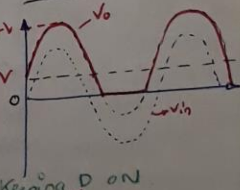


KVL: $V_{in} - V - V_D - V_o = 0$

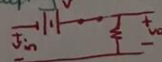
$V_o = V_m - V$ o/p follows V_{in} with a shift of 'V'

Clipper 4:





Bias vtg V aids V_{in} in Keeping D ON



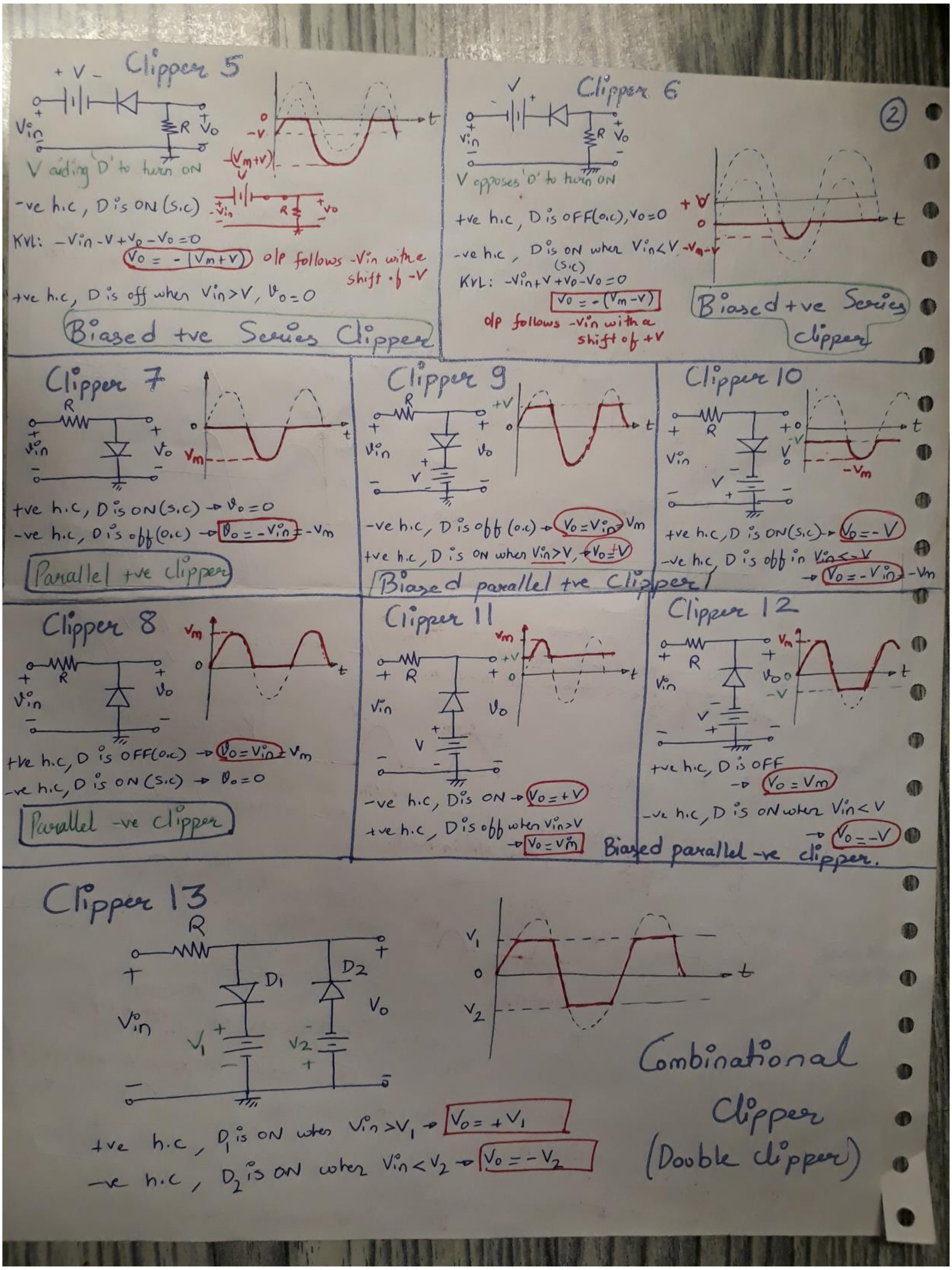
- +ve h.c :→ D is ON (s.c)

KVL :- $V_{in} + V - V_D - V_o = 0$

$V_o = V_m + V$ o/p follows V_{in} with a shift of +V

-ve h.c :→ D is off when $V_{in} < V$ ie (o.c), $V_o = 0$

Biased -ve series clipper


Clipper 5
V aiding 'D' to turn ON
-ve h.c, D is ON (s.c)
KVL: -Vin -V +Vo -Vo = 0
Vo = -(Vm+V)
o/p follows -Vin with a shift of -V
+ve h.c, D is off when Vin > V, Vo = 0
Biased +ve Series Clipper
Clipper 6
V opposes 'D' to turn ON
+ve h.c, D is OFF(o.c), Vo = 0
-ve h.c, D is ON when Vin < V (s.c)
KVL: -Vin + V + Vo - Vo = 0
Vo = -(Vm-V)
o/p follows -Vin with a shift of +V
Biased +ve Series clipper
Clipper 7
+ve h.c, D is ON(s.c) → Vo = 0
-ve h.c, D is off(o.c) → Vo = -Vin = -Vm
Parallel +ve clipper
Clipper 9
-ve h.c, D is off (o.c) → Vo = Vin = Vm
+ve h.c, D is ON when Vin > V, Vo = +V
Biased parallel +ve Clipper
Clipper 10
+ve h.c, D is ON(s.c) → Vo = -V
-ve h.c, D is off in Vin < -V → Vo = -Vin = -Vm
Clipper 8
+ve h.c, D is OFF(o.c) → Vo = Vin = Vm
-ve h.c, D is ON (s.c) → Vo = 0
Parallel -ve clipper
Clipper 11
-ve h.c, D is ON → Vo = +V
+ve h.c, D is off when Vin > V → Vo = Vin
Clipper 12
+ve h.c, D is OFF → Vo = Vm
-ve h.c, D is ON when Vin < V → Vo = -V
Biased parallel -ve clipper.
Clipper 13
+ve h.c, D1 is ON when Vin > V1 → Vo = +V1
-ve h.c, D2 is ON when Vin < V2 → Vo = -V2
Combinational Clipper (Double clipper)