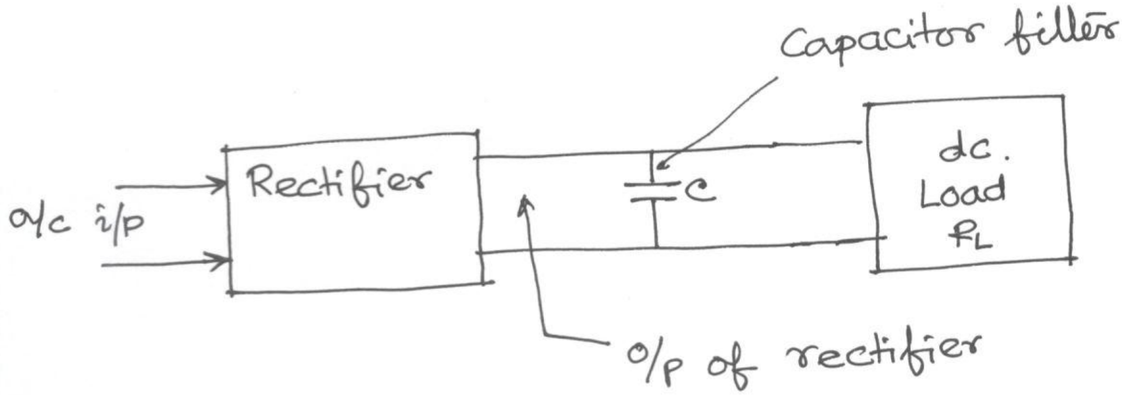
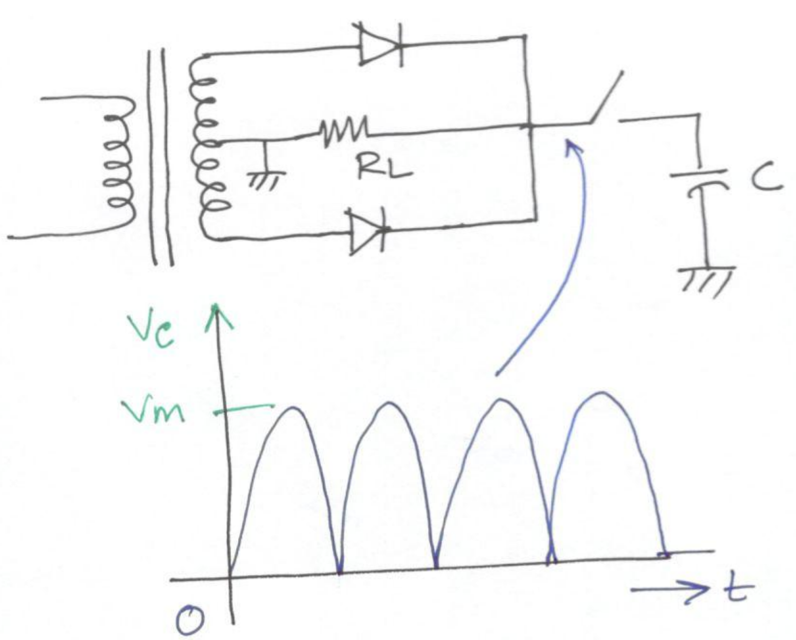
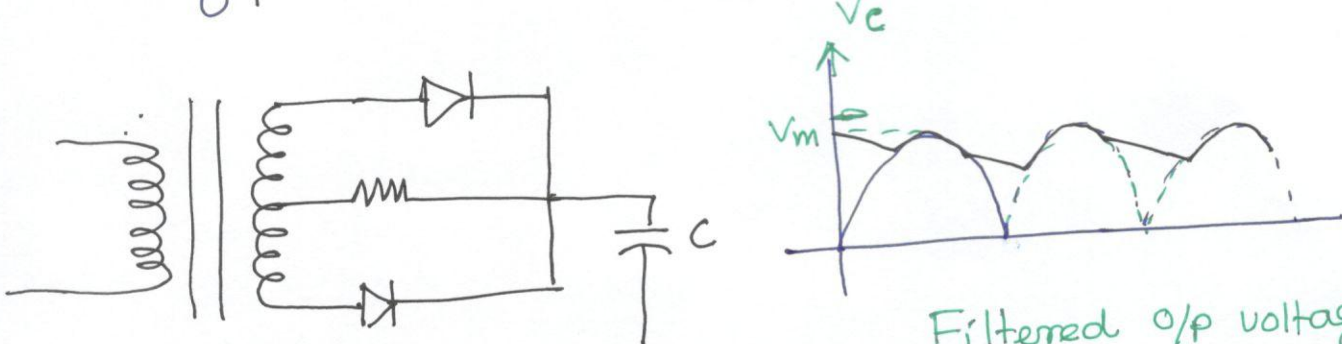
Capacitor Filter

A capacitor is connected at rectifier output dc voltage is obtained across the capacitor.

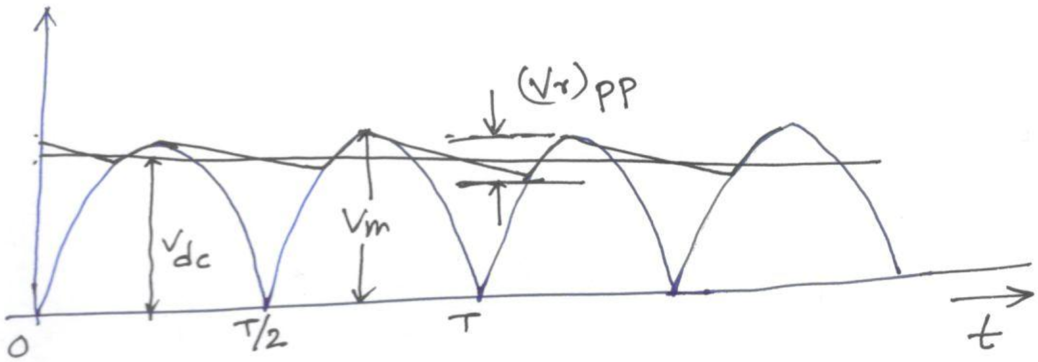


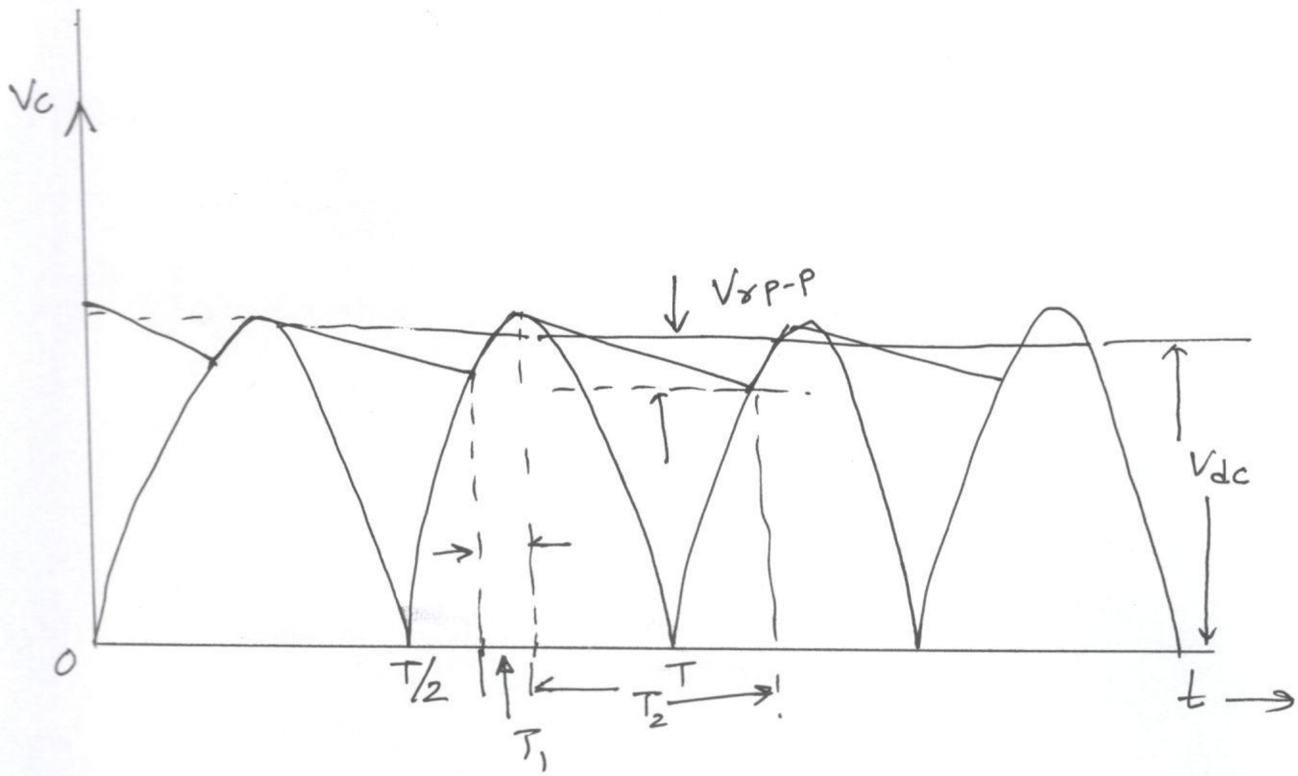




Full wave rectifier.

Filtered o/p voltage





ripple voltage

$$V_r(\text{rms}) = \frac{I_{dc}}{4\sqrt{3}\, fC} = \frac{2.4\, I_{dc}}{C}$$

$$= \frac{2.4\, V_{dc}}{R_L C}$$

I_{dc} : milliamp.

C : microfarad

R_L : Kilo Ω

T_1 : diode conducts and charges C to V_m

T_2 : Rectifier voltage drops below the peak and capacitor discharges through load.

Avg ct drawn from the supply = avg of the ct through the diode during charging

$$I_{dc} \cdot T = I_p \cdot T_1$$

or $$I_{peak} = I_p = I_{dc} \frac{T}{T_1}$$

T_1 : Diode conduction time

$T = 1/f$

small C $\Rightarrow$ large conduction time of diode

$\Rightarrow$ peak ct not very high

Large C $\Rightarrow$ small conduction time

$\Rightarrow$ very high ~~bick~~ peak ct.

(Diode peak ct)

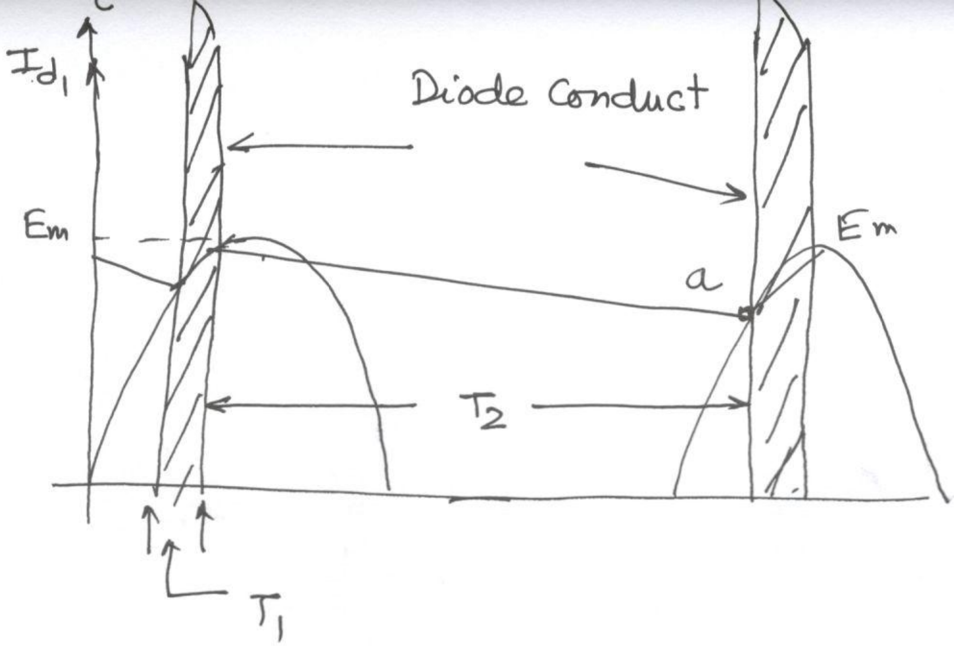
$$\cancel{V_{dc}} \quad I_{dc} \cdot T = I_p T_1$$

$$I_p = I_{dc} \cdot \frac{T}{T_1}$$

$$V_{dc} = V_m - \frac{I_{dc}}{4fC} = V_m - \frac{4 \cdot 17\, I_{dc}}{C}$$

$T = 1/f$ $\quad f = 2 \times 60 = \underline{120 \text{ Hz}}$

f : ripple frequency for F.W



- For time T_1 diode conducts and charges the capacitor to Em

- After this capacitor discharges for T_2 when the voltage across C falls below the rectified voltage, say at a point a, the diode conduction starts. and C is charged to Em.

- The average ct supplied to the capacitor and load must be = avg ct drawn from the capacitor during T_2.

- Diode conducts for small period of time

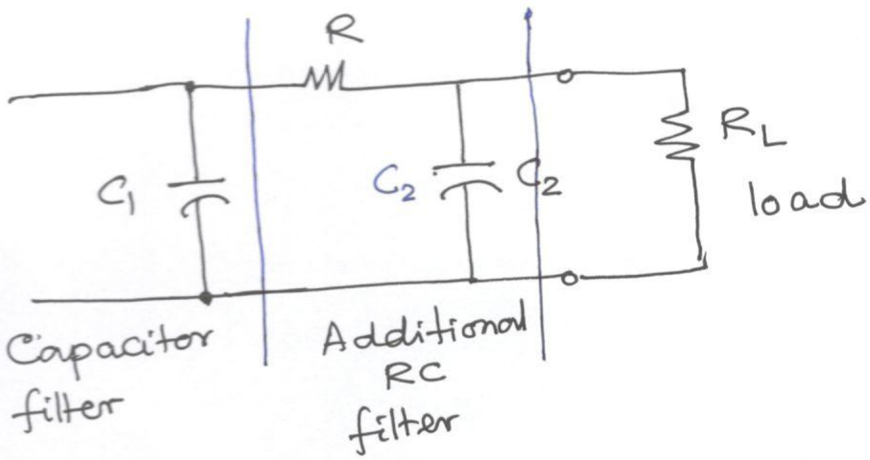
- Larger the C ⇒ less the voltage decay ⇒ shorter the interval of charging.

But diode has to supply same avg ct

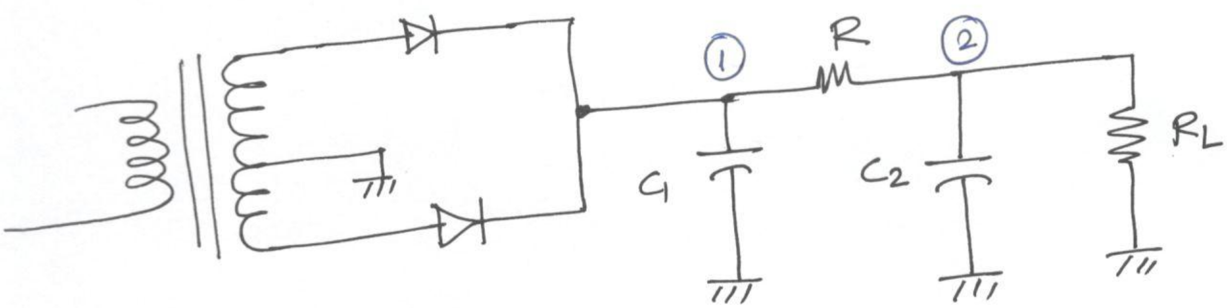
⇒ peak ct increases.

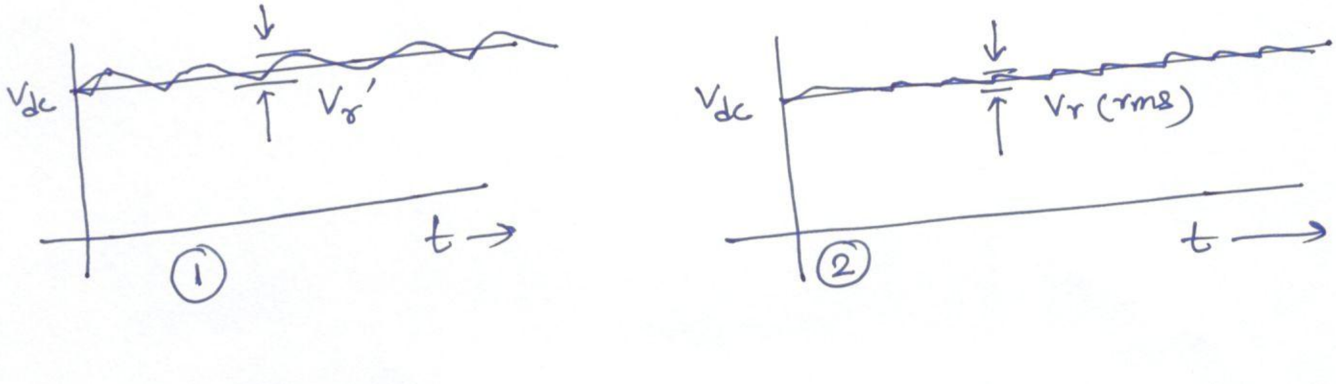
RC Filter

- It is possible to further reduce the amount of ripple across a filter capacitor by using an additional RC filter.

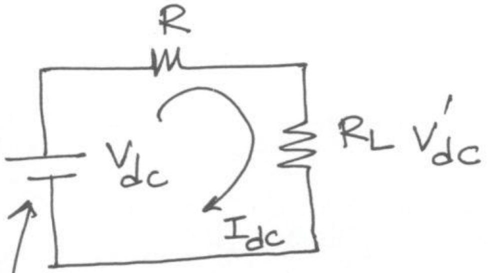


- The added RC section passes most of the d.c. component while attenuating as much as the a.c. component



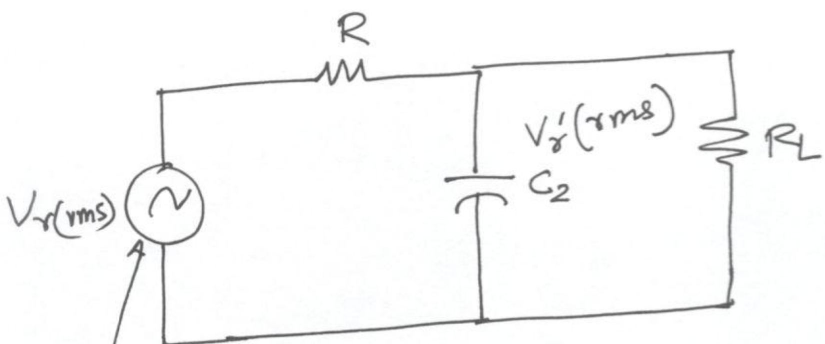


DC operation of RC Filter Section



D.C. voltage developed across C_1

$$V'_{dc} = V_{dc} \cdot \frac{R_L}{(R + R_L)}$$



A.C. ripple voltage developed across C_1

$$V'_r(rms) \approx \frac{X_C}{R} V_r(rms)$$

$V'_r(rms)$: AC. Component of voltage across load.

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 120 \times C} = \frac{1.3}{C}$$

X_C is in $K\Omega$, if C is in μF.