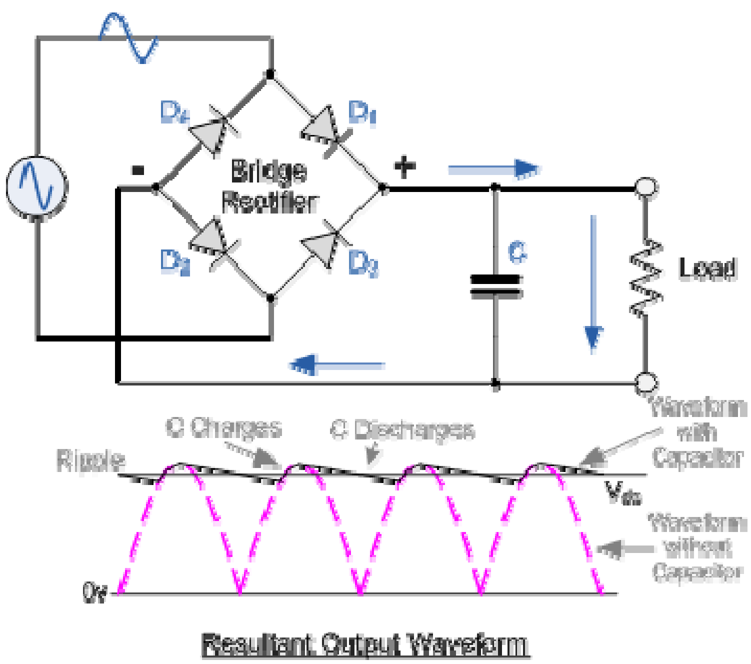
CAPACITOR FILTER

This filter is used for high load resistances which are connected directly across the load. The property of capacitor is that it blocks the d.c. and allows a.c. The operation of capacitor filter is to short the ripple to ground but use the dc to appear at load resistance.



During +ve half-cycle D_1 conducts as it is forward biased and D_2 is reverse biased. When transformer voltage is greater than cut in voltage of diode then diode D_1 starts conducting effectively. The capacitor is fully charged when $V_C = V_m$. Now the capacitor discharges through R_L slowly until transformer secondary voltage again increases the value greater than cut in voltage. During discharging diode D1 stops conducting.

During –ve half-cycle D_2 is forward biased and conducts when T-sec voltage reaches cut in voltage upto $V_C = V_m$. After capacitor discharges til T_{sec} voltage again increases to a value greater than cut in voltage. During discharging D_2 stops conducting.

This process d is repeated.

Ripple voltage waveform can be assumed to be triangular waveform.

During the time interval T_2 the capacitor 'c' is discharging to R_L

$Q = CV_{\gamma\ p-p}$ = charge acquired by capacitor.

$$i = \frac{d\theta}{dt}$$

$\theta = \int_0^{T_2} idt = I_{dc}T_2$ = charge lost by the capacitor.

Charge acquired by the capacitor = charge lost by capacitor.

$$CV_{\gamma\ p-p} = I_{dc}T_2 \qquad - \qquad (2)$$

$$CV_{\gamma\ p-p} = \frac{I_{dc}T_2}{C}$$

$$T = 2(T_1 + T_2)$$

Charging time << discharging time

$$T_1 \le< T_2$$

$$\therefore T \approx 2T_2 \qquad - \qquad (3)$$

$$\therefore T_2 \approx \frac{T}{2}$$

$$\boxed{\therefore V_{\gamma\ p-p} = \frac{I_{dc}T}{2C}}$$

$$V_{\gamma\ p-p} = \frac{I_{dc}}{2fC} \qquad - \qquad (4)$$

Ripple factor, $\gamma = \frac{V'_{rms}}{V_{dc}}$

$$V'_{rms} = \frac{V_{\gamma\ p-p}}{2\sqrt{3}} = \frac{\frac{I_{dc}}{2\,fC}}{2\sqrt{3}} = \frac{I_{dc}}{2\sqrt{3}\,fC}$$

$$= \frac{V_{dc}}{4\sqrt{3}\,fCR_L}$$

$$\boxed{\gamma = \frac{1}{4\sqrt{3}\,fCR_L}}$$

Advantages :

Capacitor filter is used particularly when load resistance is high or load current is low.

If $f = 50Hz \qquad C\ is\ in\ \mu G, \quad R\ is\ in\ \Omega$

$$\gamma = \frac{0.2886}{CR_L} \times 10_4 = \frac{2890}{CR_L}$$

FOR HWR:

$$V'_{rms} = \frac{V_{\gamma\ p-p}}{2\sqrt{3}}$$

$$T = T_1 + T_2$$
$$T_1 << T_2$$
$$T \approx T_2$$

$$\gamma = \frac{V'_{rms}}{V_{dc}} = \frac{1}{2\sqrt{3}R_L\,fC}$$