

Experiment 6 Diode characteristic and Applications

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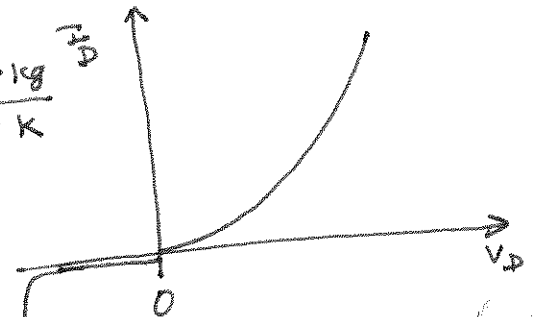
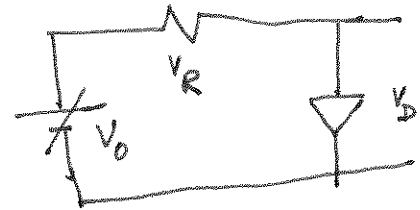
1. Diode Characteristics

$$I = \begin{cases} I_0 e^{qV_D/kT} & V_D > 0 \\ -I_0 & V_D < 0 \end{cases}$$

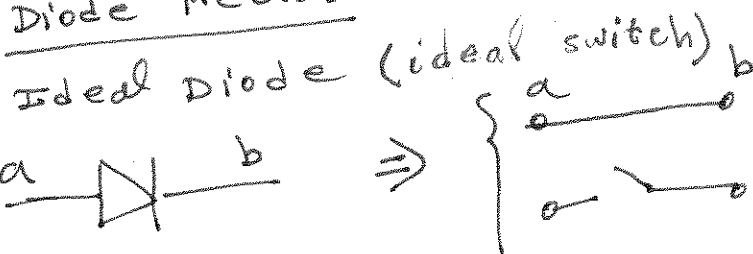
q : Electron charge $= 1.6 \times 10^{-19} \text{ C}$

k : Boltzman's constant $= 1.38 \times 10^{-23} \frac{\text{m}^2 \text{kg}}{\text{s}^2 \text{K}}$

T : Temperature in kelvin. $(273+30)$

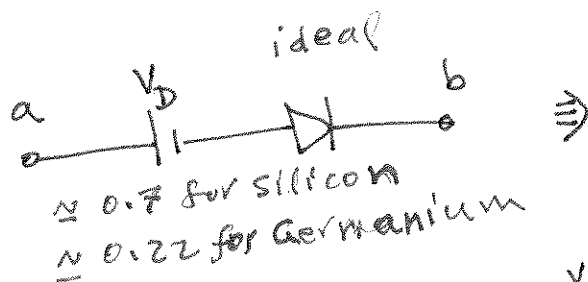


Diode Models:

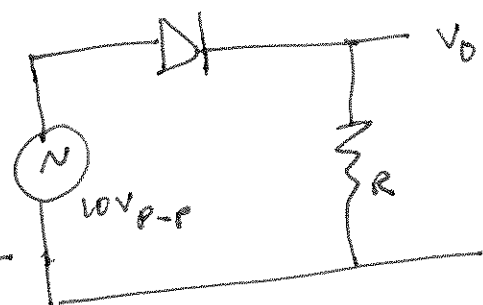
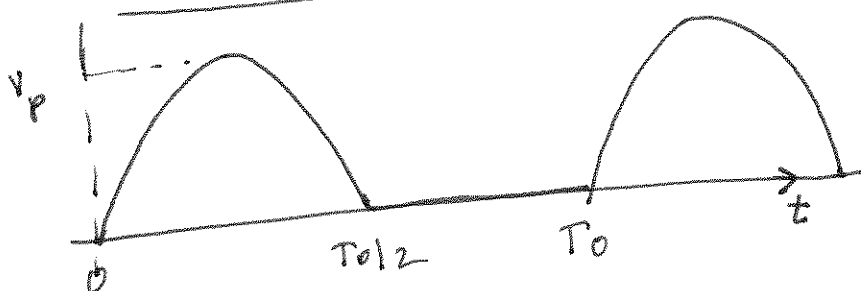


when $V_a > V_b$ short
" $V_a < V_b$ open

Practical Diode



Half-Wave Rectification

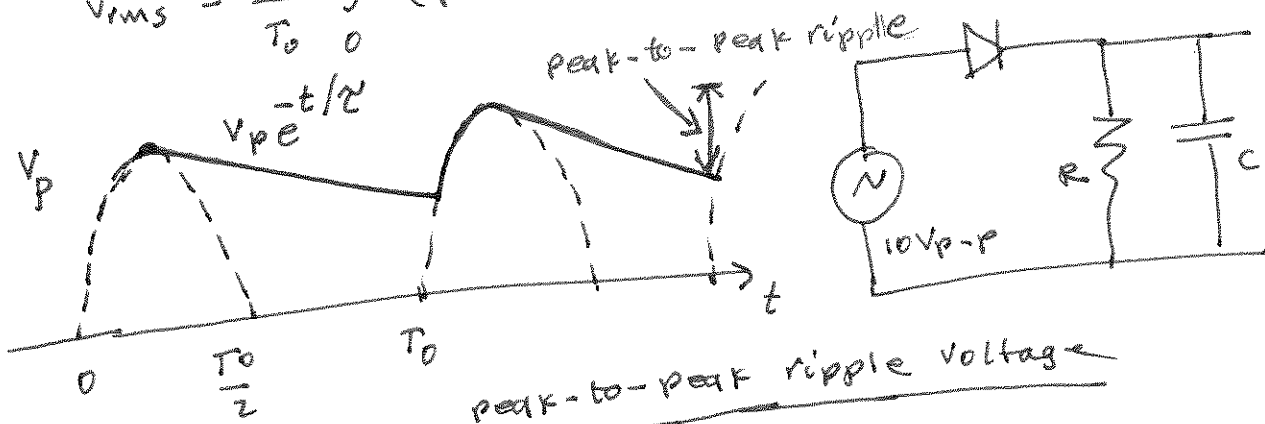


DC and RMS values

$$V_{av} = \frac{1}{T_0} \int_0^{T_0/2} V_p \sin \omega_0 t \, dt = \frac{V_p}{\pi} = \frac{1}{\pi} \text{ Peak voltage}$$

(2)

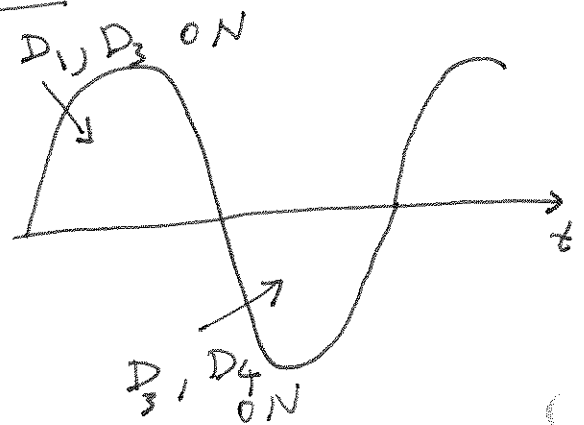
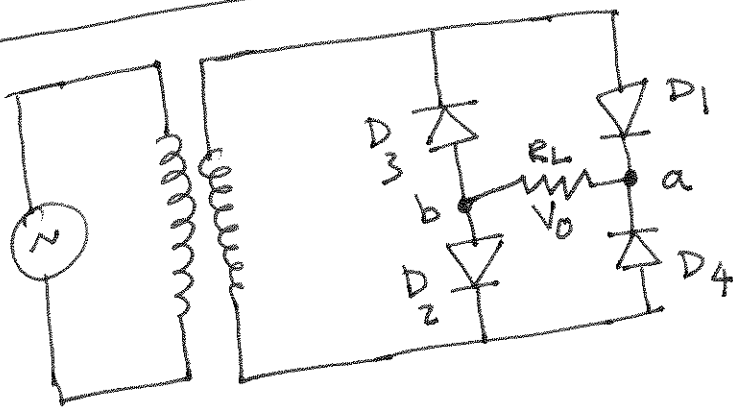
$$V_{rms}^2 = \frac{1}{T_0} \int_0^{T_0/2} (V_p \sin \omega t)^2 \, dt \Rightarrow V_{rms} = \frac{V_p}{2\sqrt{2}}$$



$$\text{ripple factor} = \frac{\text{peak-to-peak ripple voltage}}{V_p}$$

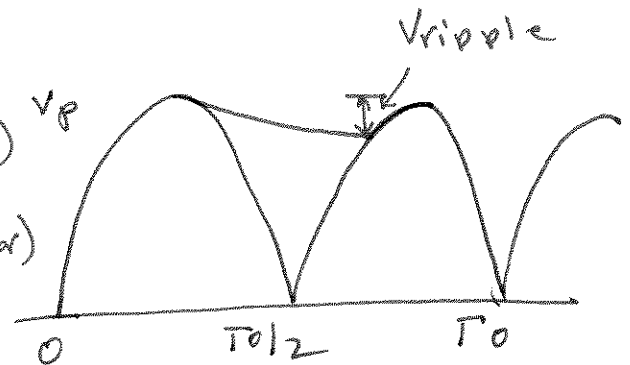
$$V_{dc} \approx V_p - \frac{\text{peak-to-peak ripple voltage (with capacitor)}}{2}$$

Full-Wave Rectification: Diode Bridge



$$V_{av} = \frac{2V_p}{\pi} \quad (\text{without capacitor})$$

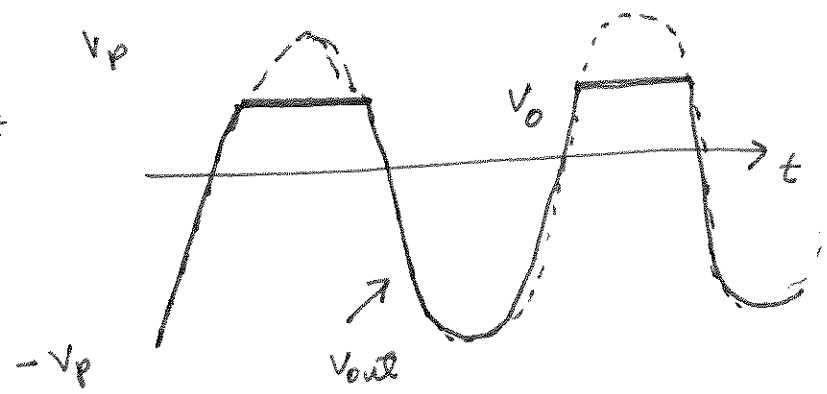
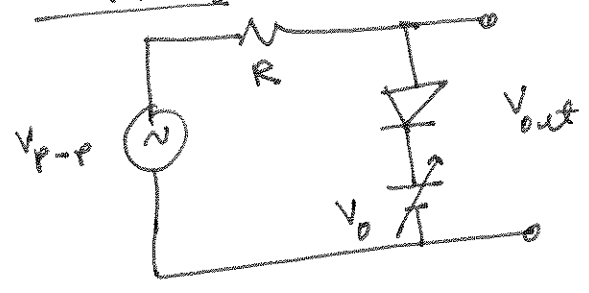
$$V_{rms} = \frac{V_p}{\sqrt{2}} \quad (\text{without capacitor})$$



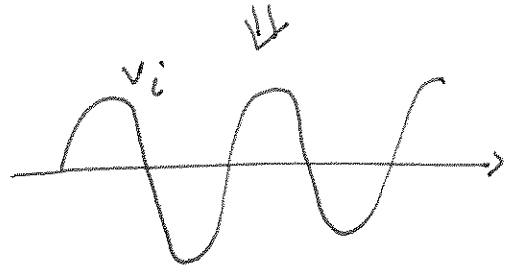
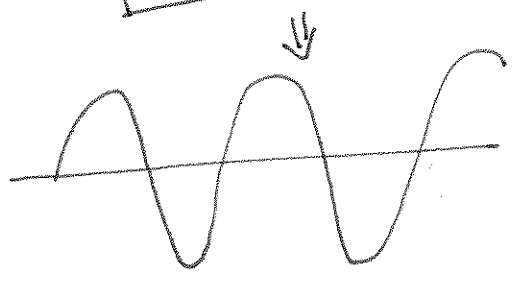
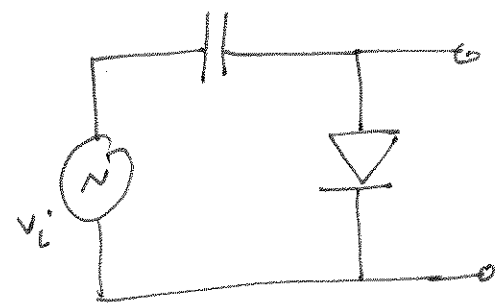
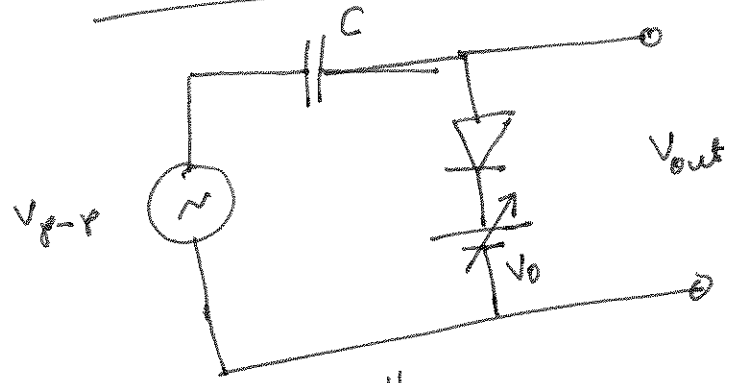
Adding a capacitor in parallel with R_L improves the dc value and reduces the ripple factor.

$$V_{av} = V_p - \frac{V_{ripple}}{2} \quad \text{with capacitor}$$

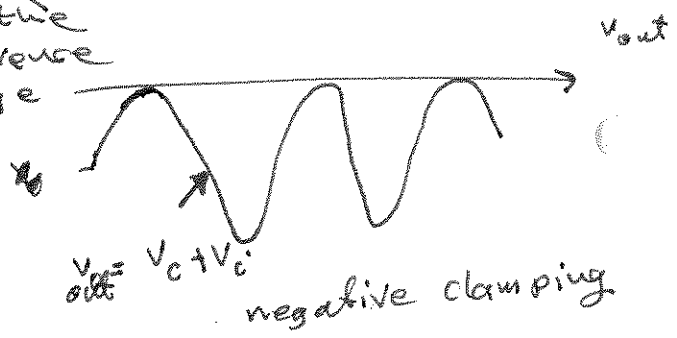
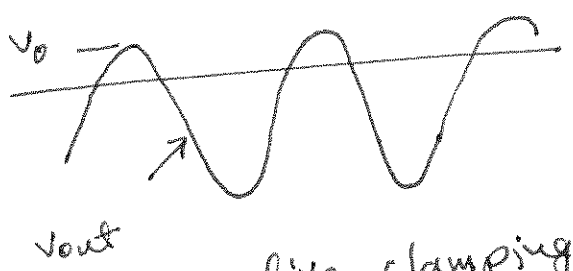
clipping :



clamping ;



waveform shifted up due to the +ve reference voltage



negative clamping.

Voltage Multiplication Circuit

