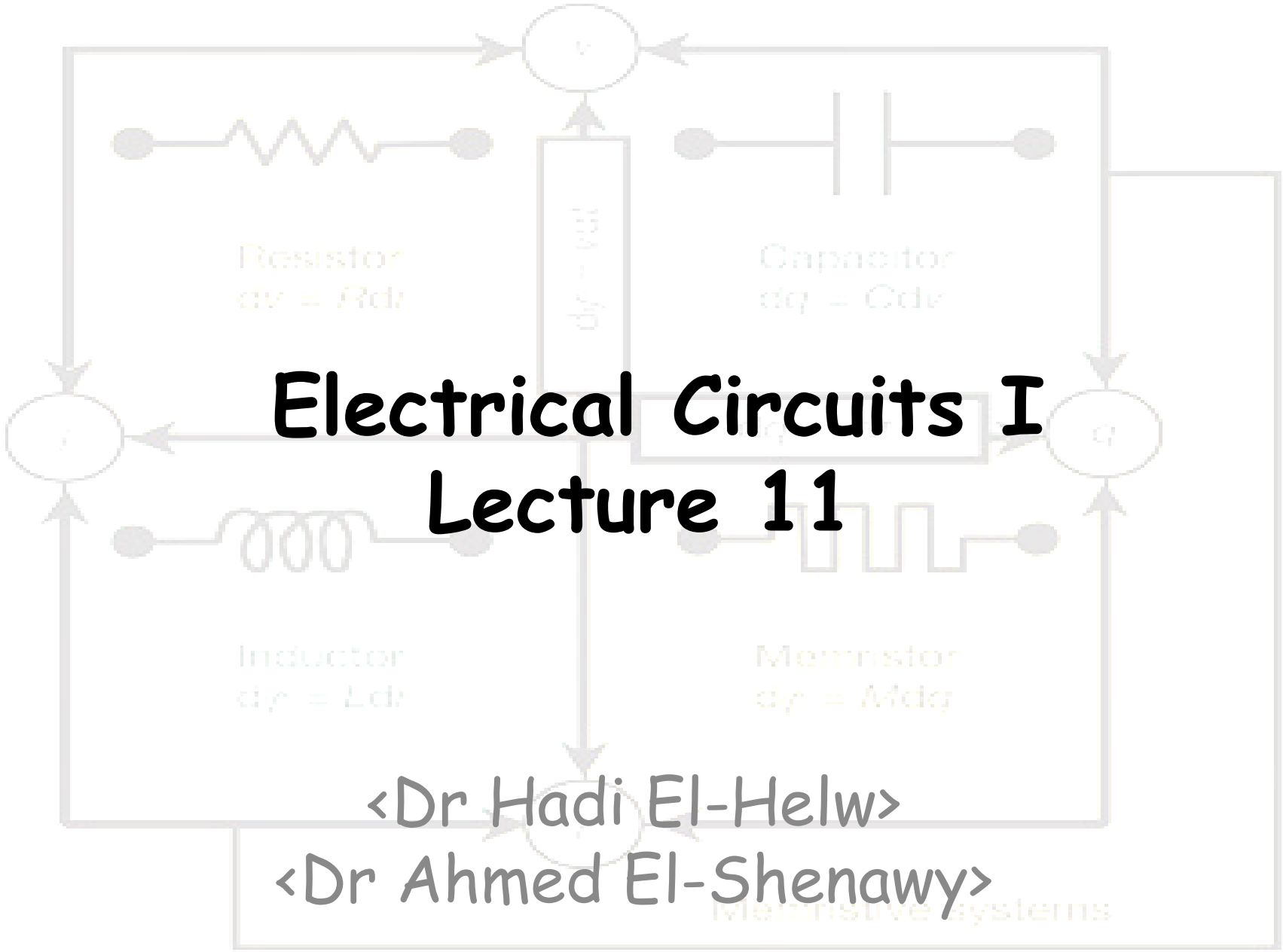

Electrical Circuits I
Lecture 11

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Root Mean Square (RMS) value

- Most AC instruments are calibrated to show the RMS value of the voltage or current and not the peak value

- When the value of an AC voltage or current is given it is understood that it is the RMS value.

- The RMS value is sometimes called the effective value of the AC voltage.

- The root mean square value of an alternating current is given by that steady (d.c.) current which when flowing through a given circuit for a given time produces the same heat as produced by the alternating current when flowing through the same circuit for the same time.

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$$

Square

Mean

Root

The Root Square value of a sine wave

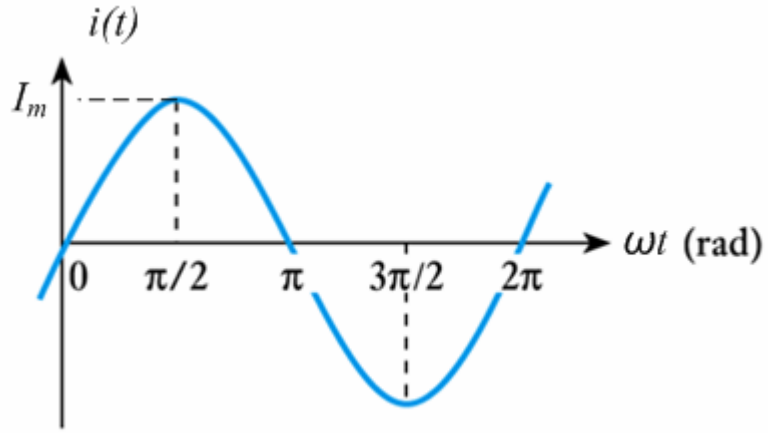
$$v(t) = V_m \sin \omega t = V_m \sin \theta$$

$$V_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} (V_m \sin\theta)^2 \, d\theta}$$

$$V_{rms} = \sqrt{\frac{V_m^2}{2\pi}\int_o^{2\pi} \frac{1}{2}(1-\cos 2\theta) d\theta}$$

$$V_{rms} = \sqrt{\frac{V_m^2}{4\pi}\left(\theta - \frac{\sin 2\theta}{2}\right)_0^{2\pi}}$$

$$V_{rms} = \sqrt{\frac{V_m^2}{4\pi}\left((2\pi - \frac{\sin 4\pi}{2}) - (0 - \sin 0)\right)} = \frac{V_m}{\sqrt{2}} = 0.707 V_m$$



r.m.s value of current or voltage= 0.707 x max. value of current or voltage

Form factor

for any waveform the form factor is defined as

$$\text{Form factor} = \frac{\text{r.m.s. value}}{\text{average value}}$$

for a sine wave this gives

$$\text{Form factor} = \frac{0.707\,V_m}{0.637\,V_m} = 1.11$$

Peak factor

for any waveform the peak factor is defined as

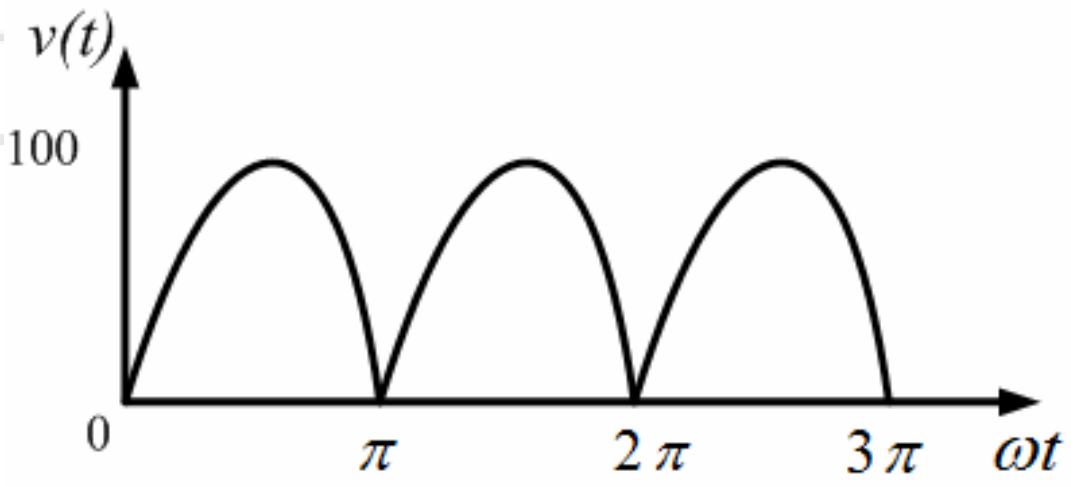
$$\text{Peak factor} = \frac{\text{peak value}}{\text{r.m.s. value}}$$

for a sine wave this gives

$$\text{Peak factor} = \frac{V_m}{0.707\,V_m} = 1.414$$

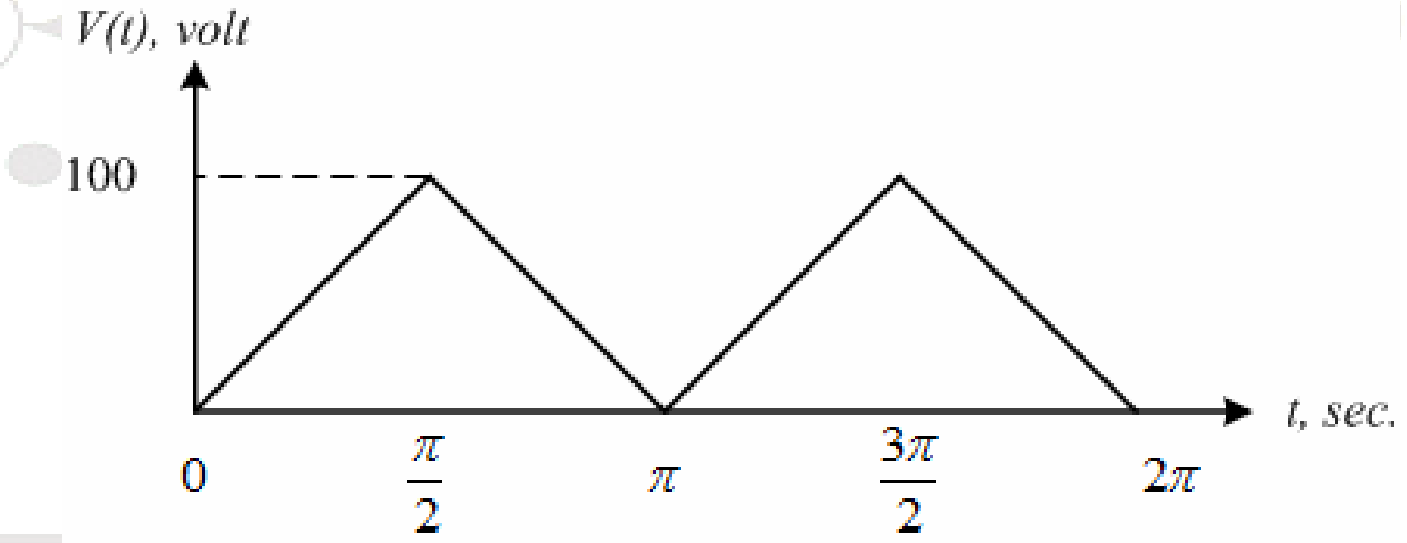
Example 1:

Determine the form factor and the peak factor of the voltage waveform shown below.



Example 2:

Determine the form factor and the peak factor of the voltage waveform shown below.



Example 3:

Determine the form factor and the peak factor of the voltage waveform shown below.