TUTORIAL 2 MEASUREMENT OF VOLTAGES AND CURRENTS

2.1 Sketch three common forms of alternating waveform.

2.2 A sine wave has a period of 10 s. What is its frequency (in hertz)?

2.3 A square wave has a frequency of 25 Hz. What is its period?

2.4 A triangular wave (see textbook Figure 2.1) has a peak amplitude of 2.5 V. What is its peak-to-peak amplitude?

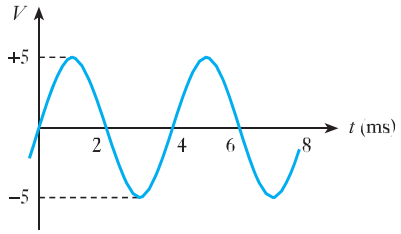
2.5 What is the peak-to-peak current of the waveform described by the following equation?

$$i = 10 \sin \theta$$

2.6 A signal has a frequency of 10 Hz. What is its angular frequency?

2.7 A signal has an angular frequency of 157 rad/s. What is its frequency in hertz?

2.8 Determine the peak voltage, the peak-to-peak voltage, the frequency (in hertz) and the angular frequency (in rad/s) of the following waveform.



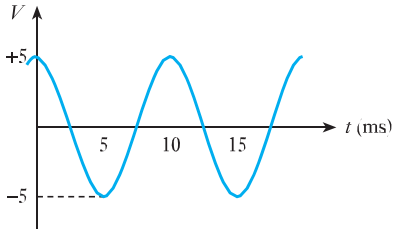
2.9 Write an equation to describe a voltage waveform with an amplitude of 5 V peak and a frequency of 50 Hz.

2.10 Write an equation to describe a current waveform with an amplitude of 16 A peak to peak and an angular frequency of 150 rad/s.

2.11 What are the frequency and peak amplitude of the waveform described by the following equation?

$$v = 25 \sin 471t$$

2.12 Determine the equation of the following voltage signal.



2.13 A sine wave has a peak value of 10. What is its average value?

2.14 A sinusoidal current signal has an average value of 5 A. What is its peak value?

2.15 Explain what is meant by the mean-square value of an alternating waveform. How is this related to the r.m.s. value?

2.16 Why is the r.m.s. value a more useful quantity than the average value?

2.17 A sinusoidal voltage signal of 10 V peak is applied across a resistor of 25 Ω. What power is dissipated in the resistor?

2.18 A sinusoidal voltage signal of 10 V r.m.s. is applied across a resistor of 25 Ω. What power is dissipated in the resistor?

2.19 A sinusoidal waveform with an average voltage of 6 V is measured by an analogue multimeter. What voltage will be displayed?

2.20 A square-wave voltage signal has a peak amplitude of 5 V. What is its average value?

2.21 A square wave of 5 V peak is applied across a 25 Ω resistor. What will be the power dissipated in the resistor?

2.22 A moving-coil meter produces a full-scale deflection for a current of 50 μA and has a resistance of 10 Ω. Select a shunt resistor to turn this device into an ammeter with an f.s.d. of 250 mA.

2.23 A moving-coil meter produces a full-scale deflection for a current of 50 μA and has a resistance of 10 Ω. Select a series resistor to turn this device into a volt-meter with an f.s.d. of 10 V.

2.24 What percentage error is produced if we measure the voltage of a square wave using an analogue multimeter that has been calibrated to display the r.m.s. value of a sine wave?

2.25 A square wave of 10 V peak is connected to an analogue multimeter that is set to measure alternating voltages. What voltage reading will this show?

2.26 Describe the basic operation of a digital multimeter.

2.27 How do some digital multimeters overcome the problem associated with different alternating waveforms having different form factors?

2.28 Explain briefly how an analogue oscilloscope displays the amplitude of a time-varying signal.

2.29 How is an analogue oscilloscope able to display two waveforms simultaneously?

2.30 What is the difference between the ALT and CHOP modes on an analogue oscilloscope?

2.31 What is the function of the trigger circuitry in an oscilloscope?

2.32 A sinusoidal waveform is displayed on an oscilloscope and has a peak-to-peak amplitude of 15 V. At the same time, the signal is measured on an analogue multimeter that is set to measure alternating volt- ages. What value would you expect to be displayed on the multimeter?

2.33 Comment on the relative accuracies of the two measurement methods outlined in the last exercise.

2.34 What is the phase difference between waveforms *A* and *B* in the following oscilloscope display? Which waveform is leading and which lagging?