ECT150
Homework #7 Problem Set
Sr. Professor Wheeler

Chapter 11 problems 1-13
Chapter 12 problems 1-10

Total Points: 23 (1 per problem)

All work must be shown, and final answers boxed or underlined. No credit if work is not shown.

(Chapter 11)

1. What is the period of a 2 kHz voltage?

$$T = 1/f = 1/2kHz = \underline{\underline{0.5mS}}$$

2. What is the frequency of an AC signal having a period of 0.2 μS?

$$f = 1/T = 1/0.2\mu S = \underline{\underline{5MHz}}$$

3. How much time does one cycle of 60 Hz AC require?

$$T = 1/f = 1/60Hz = \underline{\underline{16.67mS}}$$

4. The peak value of a sine wave is 169.73 volts. What is its effective (RMS) value?

$$V_{RMS} = \frac{V_p}{\sqrt{2}} \approx 0.707 \times V_p \approx (0.707)(169.73V) = \underline{\underline{120V}}$$

5. What is the frequency of a signal having one-fourth the period of a signal whose T equals 0.01 s?

$$T = 0.01s/4 = 2.5mS$$
$$f = 1/T = 1/2.5mS = \underline{\underline{400Hz}}$$

6. What is the peak-to-peak voltage across a 10k resistor that is dissipating 50 mW?

$$V_{RMS} = \sqrt{PR} = \sqrt{(50mW)(10k\Omega)} = 22.36V$$
$$V_{pp} = 2V_p = 2 \times V_{RMS} \times \sqrt{2} = (2)(22.36V)(\sqrt{2}) = \underline{\underline{63.25Vp}}$$

Note: When doing power calculations, an RMS voltage is always involved.

7. If the RMS value of an AC voltage doubles, the peak-to-peak value must also double.

8. The AC effective (RMS) voltage across a given resistor doubles. What happens to the power dissipated by the resistor?

Since $P = \frac{V^2}{R}$, we know that the power will quadruple (4X) when the voltage doubles.

9. The period of an AC signal triples. What must have happened to the frequency of the signal?

The frequency must have become 1/3 (one-third) of the original value, since *f*=1/T. Increasing T decreases *f*.

10. The RMS value of a given AC voltage is 75V. What is the peak value? What is the peak-to-peak value?

a) $V_p = V_{RMS}\sqrt{2} = (75V)\sqrt{2} = \underline{\underline{106Vp}}$

b) $V_{pp} = 2V_p = 2(106V_p) = \underline{\underline{212V_{pp}}}$

11. What time is needed for one alternation (cycle) of a 500 Hz AC signal?

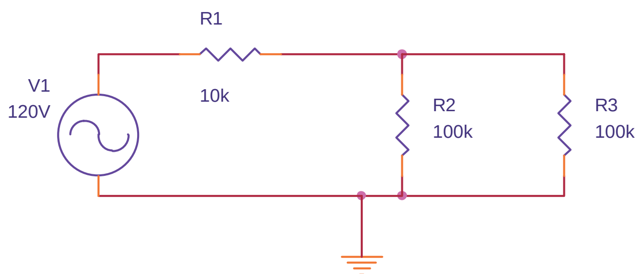
$T = 1/f = 1/500Hz = \underline{\underline{2mS}}$

12. One alternation (cycle) of a signal takes 500 μs. What is its frequency? What is the time of two periods?

a) $f = 1/T = 1/500\mu s = \underline{\underline{2kHz}}$

b) Two periods: $2T = 2(500\mu s) = \underline{\underline{1000\mu s}}$ (“Duh!”)

13. Draw the diagram of a three-resistor series-parallel circuit having a 10k resistor R1 in series with the source, and two 100 k resistors (R2 and R3) in parallel with each other and in series with R1. Assume a 120 VAC source. Calculate the following parameters: V_{R1}, I_{R1}, P_{R1}, I_{R2}, V_{R3}.



$$R_T = R1 + R2 \parallel R3 = 10k + 50k = 60k$$

a) $I_T = V_T / R_T = 120V / 60k = 2mA$

$V_{R1} = I_{R1} R_1 = (2mA)(10k) = \underline{\underline{20V}}$

b) $I_{R1} = I_T = \underline{\underline{2mA}}$ (Calculated in step “a”)

c) $P_{R1} = I_{R1}^2 R_1 = (2mA)^2 (10k) = \underline{\underline{40mW}}$

d) $I_{R2} = I_T / 2 = 2mA / 2 = \underline{\underline{1mA}}$ By inspection, since (R2 == R3)

e) $V_{R3} = V_T - V_{R1} = 120V - 20V = \underline{\underline{100V}}$ By KVL (Could have also used I_{R3} X R_3

(Chapter 12)

1. The time/div control and horizontal gain control settings are set so that the horizontal sweep line represents 0.1 ms/division. What is the frequency of a signal if one displayed cycle uses four horizontal divisions?

$$T = 4div \times \frac{0.1mS}{div} = 0.4mS$$

$$f = 1/T = 1/0.4mS = \underline{\underline{2.5kHz}}$$

2. If the controls are set so that the horizontal sweep line represents 2.5 ms/division, what is the frequency of a signal if a single displayed cycle uses 8 horizontal divisions on the horizontal sweep line?

$$T = 8div \times \frac{2.5mS}{div} = 20mS$$

$$f = 1/T = 1/20mS = \underline{\underline{50Hz}}$$

3. For a frequency double that calculated in question 2, how many horizontal divisions would a single cycle take if the sweep controls were set so that each horizontal division represented 5 ms?

Given that the frequency would be 2 X 50 Hz or 100 Hz, we first find the time:

T=1/f=1/100Hz = 10 mS

And the number of divisions:

$$div = 10ms \times \frac{1div}{5mS} = \underline{\underline{2div}}$$

4. What is the peak to peak voltage indicated by the display of Figure 12-19?

$$V_{pp} = 6div \times \frac{5V}{div} = \underline{\underline{30V_{pp}}}$$

5. What is the value of T for the signal displayed?

$$T = 4div \times (1ms / div) = \underline{\underline{4ms}}$$

6. If you want to display to show only one cycle of the signal, which controls do you adjust on an oscilloscope?

<u>To adjust how much time appears, adjust the horizontal timebase controls</u>.

7. What is the time per division setting to display one cycle of the waveform in Figure 12-19?

The total time period of the signal is 4 ms. This needs to be spread out over 10 horizontal divisions. Therefore, the setting must be 4ms/10div or <u>0.4 ms/div</u>.

8. The vertical sensitivity is 5V/div in Figure 12-19. What the RMS, peak, and peak-to-peak values of the signal?

a) $V_p = 3div \times 5V / div = \underline{\underline{15V_p}}$

b) $V_{pp} = 2V_p = \underline{\underline{30V_{pp}}}$

c) $V_{RMS} = V_p / \sqrt{2} = 15V_p / \sqrt{2} = \underline{\underline{10.6V}}$

9. If a scope is set with the vertical sensitivity at 2V/division, and in measuring the voltage across a 4.7k resistor with the scope the peak-to-peak deflection is 2.5 divisions, what is the RMS current through the resistor?

$$V_{pp} = 2V / div \times 2.5 div = 5V_{pp}$$

$$V_{RMS} = \frac{V_{pp}}{2\sqrt{2}} = \frac{5V_{pp}}{2\sqrt{2}} = 1.77V$$

$$I = I_{RMS} = V / R = 1.77V / 4.7k = \underline{\underline{0.38mA}}$$

10. How many cycles of a 400 Hz signal would appear across a scope having 10 horizontal divisions if the horizontal timebase is set at 0.5 ms/div?

The total time displayed on the scope face is (0.5ms/div)X(10div) = 5ms/screen

The time T of the 400 Hz signal is T=1/400Hz = 2.5 mS = 1 cycle

Therefore, we can write:

$$cycles / screen = \frac{1 cycle}{2.5 ms} \times \frac{5 ms}{1 screen} = \underline{\underline{2 cycles / screen}}$$