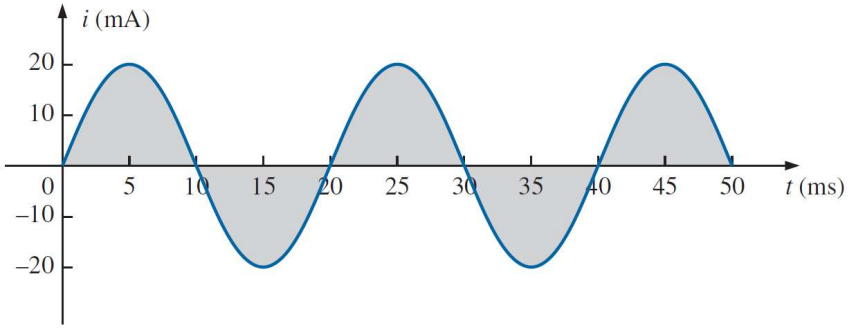
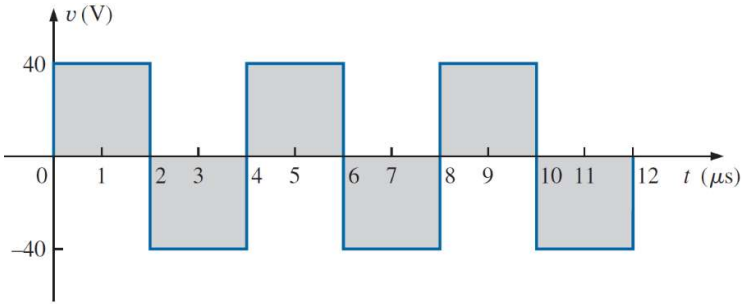
Assignment Problems #3
Subject: **Basic Electrical Engineering**

1. (i) For the waveform shown below,
a. What is the peak value?
b. What is the instantaneous value at 15 ms and at 20 ms?
c. What is the peak-to-peak value of the waveform?
d. What is the period of the waveform?
e. How many cycles are shown?



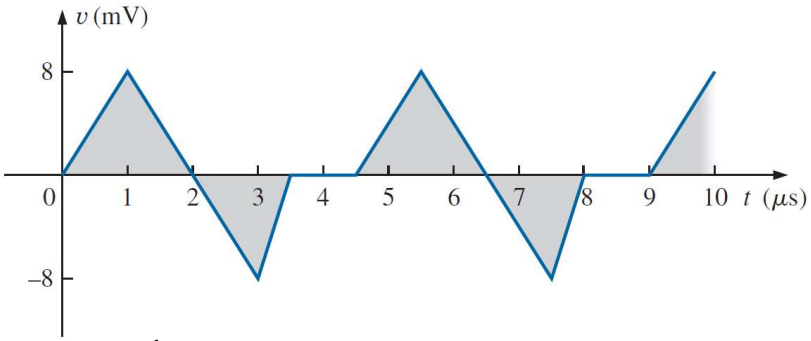
(ii) For the waveform shown below,

a. What is the peak value?
b. What is the instantaneous value at 5 ms and at 11 ms?
c. What is the peak-to-peak value of the waveform?
d. What is the period of the waveform?
e. How many cycles are shown?



(iii) For the waveform shown below,

a. What is the peak value?
b. What is the instantaneous value at 3 ms and at 9 ms?
c. What is the peak-to-peak value of the waveform?
d. What is the period of the waveform?
e. How many cycles are shown?



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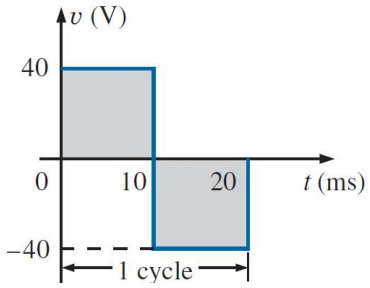
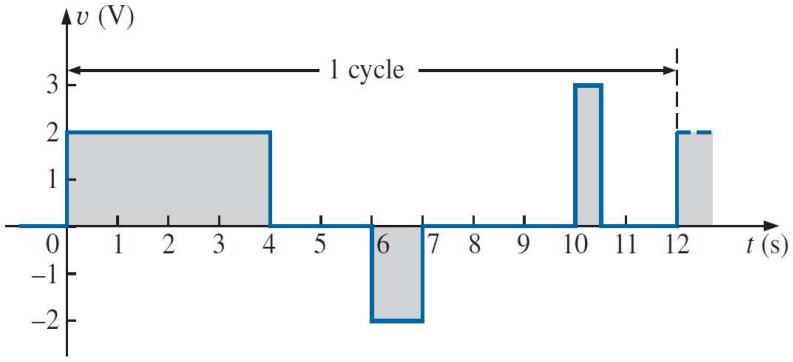
2. Determine the average and RMS values of the following waves.

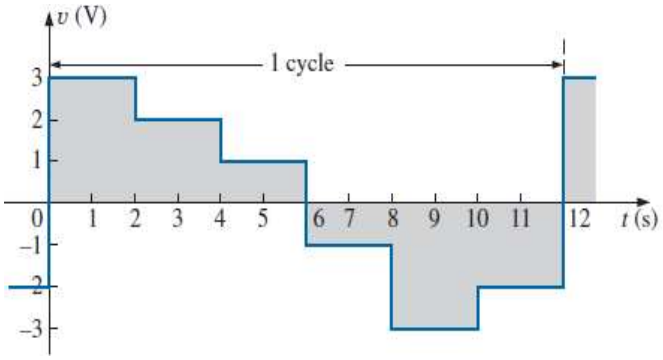
(i)



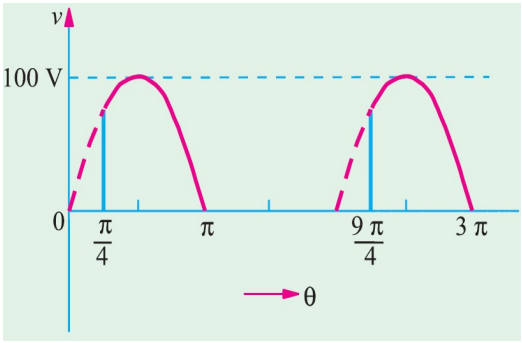
(ii)



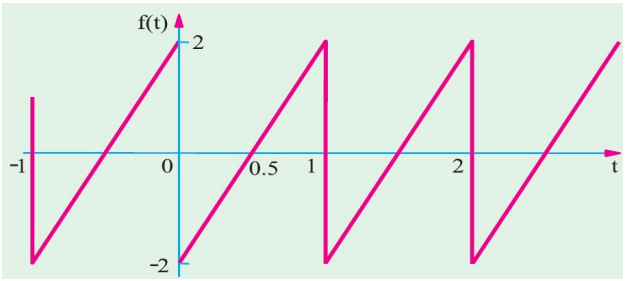
(iii)



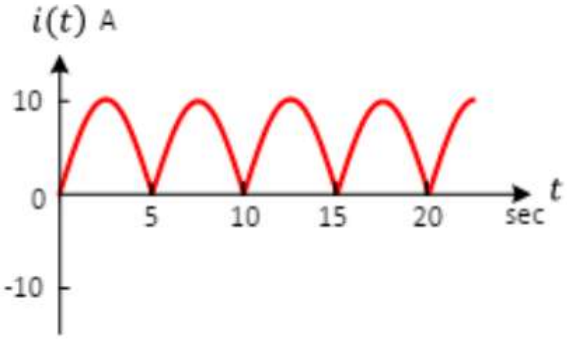
(iv) (The curves are parts of a sine wave.)



(v)



(vi) (Rectified sine wave)



[Answers: **(i)** 0 V, 40 V **(ii)** 0.625 V, 1.43 V **(iii)** 0 V, 2.16 V **(iv)** 27.2 V, 47.7 V **(v)** 0, 1.15 **(vi)** 6.37 A, 7.07 A]

3. Find the amplitude and frequency of the following waves:

a. 20 sin 377t **b.** 5 sin 754t **c.** 106 sin 10,000t **d.** 6.4 sin 942t

(Answers: **a.** 20, 60; **b.** 5, 120; **c.** 10^6, 1591.55; **d.** 6.4, 149.92)

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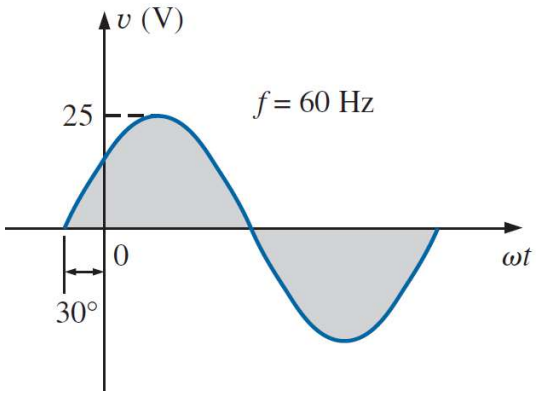
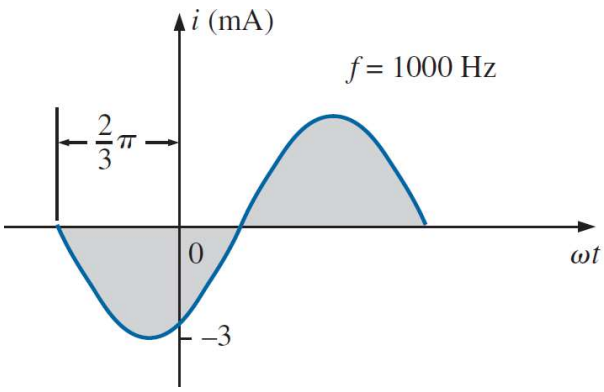
4. Write the equations of the following sinusoidal wave diagrams.

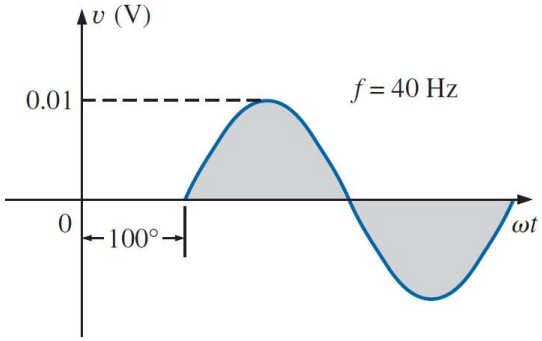
(i)



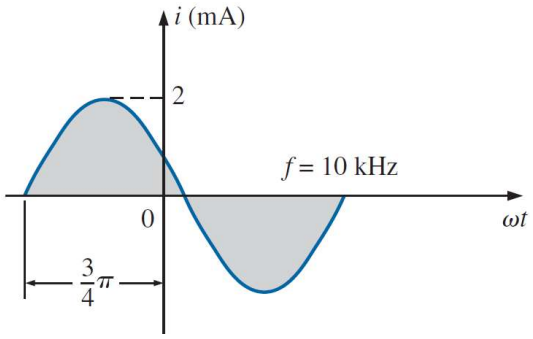
(ii)



(iii)



(iv)



5. Sketch the following waveforms:
a. 50 sin (ωt + 0°) **b.** 5 sin(ωt + 60°) **c.** 2 sin (ωt - 30°) **d.** 30 sin (ωt + 120°)

6. Three voltages are given as $\mathbf{e_1 = 20 \sin \omega t}$; $\mathbf{e_2 = 30 \sin (\omega t - \pi/4)}$ and $\mathbf{e_3 = 40 \cos (\omega t + \pi/6)}$. Express them in polar form and show in phasor diagram.

7. Two currents are given in equation form as follows.
$i_1 = 7 \sin \omega t$ and $i_2 = 10 \sin (\omega t + \pi/3)$
(a) Express in polar and rectangular form.
(b) Determine $I_1 + I_2$ and $I_1 - I_2$ by phasor diagram method.

8. An alternating current is represented by i = 70.7 sin 520 t. Determine (i) the frequency (ii) the current 0.0015 second after passing through zero, increasing positively.
[Answers: **(i)** 82.8 Hz **(ii)** 49.7 A]

9. A sinusoidal alternating voltage has an r.m.s. value of 200 V and a frequency of 50 Hz. It crosses the zero axis in a positive direction when $t = 0$. Determine (*i*) the time when voltage first reaches the instantaneous value of 200 V and (*ii*) the time when voltage after passing through its maximum positive value reaches the value of 141.4 V.

[Answers: **(i)** 0.0025 Sec **(ii)** 1/300 Sec]

10. The following three vectors are given: A = 20 + j20, B = 30 $\angle -120°$ and C = 10 + j0
Perform the following operations: (i) A – B + C (ii) AB/C and (iii) BC/A.

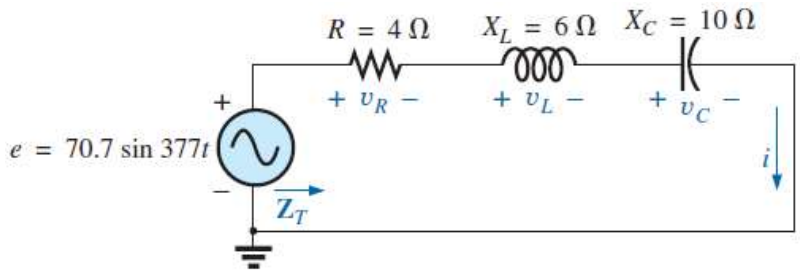
Assignment Problems #3
Subject: **Basic Electrical Engineering**

11. In a R-L series circuit, R = 3.5 Ω and L = 0.1 H. Find (i) the current through the circuit and (ii) power factor if a 220∠30° V, 50 Hz Voltage is applied across the circuit. Draw phasor diagram.
[Answers: **(i)** 6.96 ∠-53.65°, **(ii)** 0.11 (lagging)]

12. A capacitor having a capacitance of 20 μF is connected in series with a non-inductive resistance of 120 Ω across a 100-V, 50-Hz supply, Calculate (a) current (b) the phase difference between the current and the supply voltage (c) the power dissipated. Also draw the vector diagram.

[Answers: **(a)** 0.501 A **(b)** 52.9°, **(ii)** 30.2 W]

13. For the circuit given below, (i) find circuit current and the voltages across the three components, (ii) determine the power dissipated, and (iii) determine the power factor.
Draw impedance and voltage triangles.



[Answers:
(i) 8.83 ∠45° A, 35.32 ∠45° V, 52.98 ∠135° V, 88.30 ∠- 45° V **(ii)** 52.9°, **(ii)** 311.88 W, (iii) 0.707 (leading)]

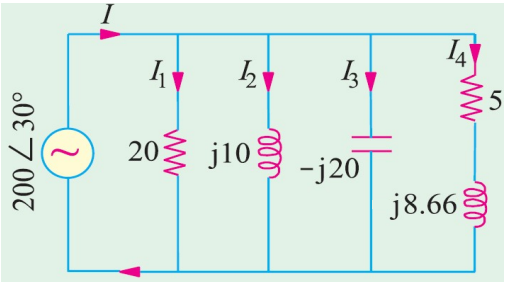
14. A series circuit, having a resistance of 10 Ω, an inductance of 0.025 H and a variable capacitance is connected to a 100-V, 25-Hz single-phase supply. Calculate the capacitance when the value of the current is 8 A. At this value of capacitance, also calculate (a) the circuit impedance (b) the circuit power factor and (c) the power consumed.

[Answers: 556 μF, **(a)** 1.5 Ω **(b)** 0.8 leading **(c)** 640 W]

15. A circuit consists of a resistance of 12 ohms, a capacitance of 320 μF and an inductance of 0.08 H, all in series. A supply of 240 V, 50 Hz is applied to the ends of the circuit. Calculate: (a) the current in the coil, (b) the potential differences across each element of the circuit and (c) the frequency at which the current would have unity power-factor.

[Answers: **(a)** 12.4 A **(b)** 149 V, 311 V **(c)** 32 Hz]

16. Calculate (i) branch currents and the total current and (ii) equivalent impedance for the four-branched circuit as shown below. Draw the phasor diagram of the circuit.



[Answers:

(i) 10 ∠30° A, 20∠-60° A, 10∠120° A, 20∠-30° A, 33.8 ∠−23.8° A
(ii) 5.9∠53.8 Ω]

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17. A parallel circuit has two branches. Branch A consists of a coil of inductance 0.2 H and a resistance of 15 Ω; branch B consists of a 30 mF capacitor in series with a 10 Ω resistor. The circuit so formed is connected to a 230-V, 50-Hz supply. Calculate (*a*) current in each branch and (*b*) line current and its power factor.

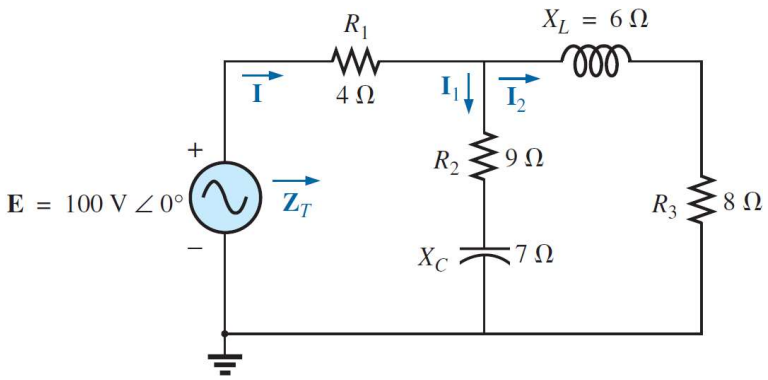
Draw the phasor diagram of the circuit.

[Answers: **(a)** 3.57 A, 2.16 A **(b)** 1.67 A, 0.616 lag]

18. An a.c. circuit consists of two parallel branches, one (A) consisting of a coil, for which R = 20 Ω and L = 0.1 H and the other (B) consisting of a 40-Ω non-inductive resistor in series with 60-μF capacitor. Calculate (i) the current in each branch (ii) the line current (iii) the power, when the circuit is connected to 230-V mains having a frequency of 50 Hz.

[Answers: **(i)** 6.15 A, 3.46 A **(ii)** 5.89 A **(iii)** 1235 W]

19. For the network below, find: (a) Calculate the total impedance $\mathbf{Z}_T$ (b) Compute **I** (c) Find the total power factor (d) Calculate $\mathbf{I}_1$ and $\mathbf{I}_2$ (e) Find the average power delivered to the circuit.



[Answers: **(a)** 10.68 ∠1.5° Ω **(b)** 9.36∠- 1.5°A **(c)** 0.9996 ≅1 **(d)** 5.5∠38.72° A, 6.27∠-36° **(e)** 935.69 W]

20. In a series-parallel circuit, two parallel branches A and B are in series with C. The impedances are $Z_A = (4 + j3)$, $Z_B = (10 - j7)$ and $Z_C = (6 + j5)$ Ω. If the voltage applied to the circuit is 200 V at 50 Hz, calculate: (a) the circuit current and the two branch currents and (b) the total power factor for the whole circuit.
Draw the complete vector diagram.

[Answers: **(a)** 16.35∠- 32.2°A, 13.7∠-51.2°, 5.7∠20.7° **(b)** 0.846 (lagging)]