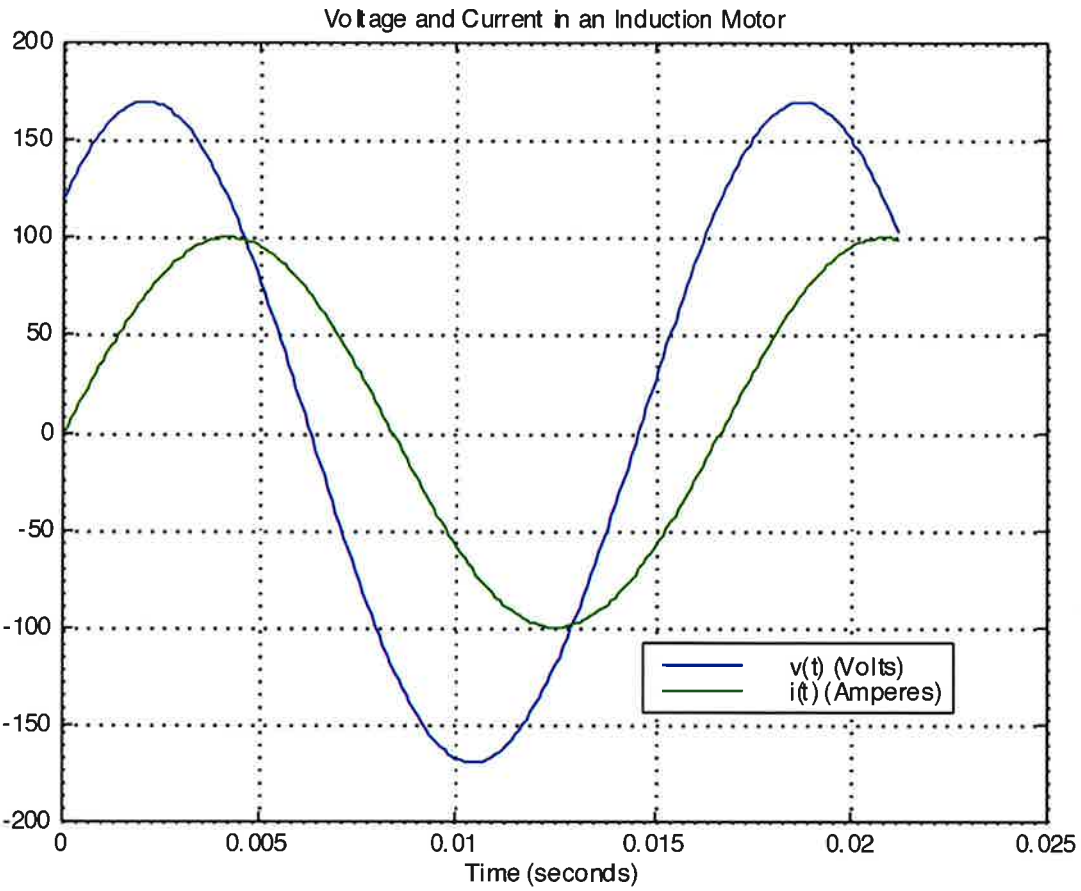
Engr228 **Final Quiz** **Spring, 2020**

SCORE KEY /16

Rules of engagement:

- This quiz will be open book:
  - You **may** use all materials at your disposal including the internet, Zybooks, textbooks, lecture notes and videos, example problems and your calculator.
  - You **may not** consult anyone other than yourself about anything related to this test until 6pm today.
- You are allowed to work on this until 6pm today providing you do it in **one sitting**. You must monitor yourself and stay within this time frame. Once you open the test, you must submit the finished product to the D2L drop box **final quiz** by 6pm.
- The drop box will close at 6pm today and late submissions will not be accepted.
- You may email me your quiz directly if D2L is not available.
- The front page of the exam asks you to sign your name. When you do, I will take this to indicate that you abided by these rules. You must sign your name to get a non-zero grade on the exam.
- Students with documented disabilities – you are responsible for providing your allowed accommodations, including appropriate time extensions. Contact me if I can be of help.
- **I will be generally available, by email only, during the hours you are allowed to take the exam.**

NAME_____



The graph above shows the voltage and current waveforms being applied to an induction motor.

The following two problems are worth one point each and refer to the figure above. Circle the best answer.

When looking at the graph:

a) The voltage is leading the current
b) The current is leading the voltage
c) The current and voltage are in phase
d) It is not possible to tell by visual inspection

If a capacitor is placed in parallel to the motor to correct the PF to unity:

a) There will be no change in the overall current drawn from the source
b) The amount of real power drawn by the motor will increase
c) The amount of reactive power drawn from the source will not change
d) The amount of real power drawn by the motor will decrease
e) None of the above

2 pts Estimate the frequency of the voltage waveform. You will need to "eyeball" the values from the graph. Express it in **both** radians/second and Hz.

$\Delta t = 16.67\ mS$

$f = \frac{1}{\Delta t} = \boxed{60\ Hz}$

$\omega = 2\pi f = \boxed{377\ Rad/Sec}$

2 pts Write the **voltage and current** expressions in sinusoidal form using **cos**, i.e. $V = V_M\cos(\omega t + \theta)$. Again, you will need to eyeball the values from the graph.

Voltage: Peak magnitude = 170V

$\phi = -45^\circ$

$\boxed{V = 170(\cos 377t - 45^\circ)\ V}$

Current: $\boxed{I = 100(\cos 377t - 90^\circ)\ A}$

3 pts What is the power factor angle? What is the power factor? Is it leading or lagging?

PF Angle $= \theta_V - \theta_I = (-45^\circ - (-90^\circ)) = \boxed{45^\circ}$

PF $= \cos(45^\circ) = \boxed{0.707}$

PF is $\boxed{\text{lagging}}$ Because the current lags the voltage

1 pt What average power is the motor using?

$P_{AVG} = \frac{1}{2} V_p I_p \cos(\theta_V - \theta_I) = \boxed{6010\ \text{watts}}$

1 pt What reactive power is the motor using?

$$P_{Reac} = \frac{1}{2} V_m I_m \sin(\theta_V - \theta_i)$$

$$= \boxed{6010 \text{ VARS}}$$

1 pt What is the apparent power?

$$P_{APP} = \sqrt{P_{Avg}^2 + P_{Reac}^2} = \boxed{8500 \text{ VA}}$$

2 pts What is the complex impedance of the motor? Express it in **polar** form.

$$Z = \frac{V}{I} = \frac{170\angle -45^\circ}{100\angle -90^\circ} = 1.7\angle 45^\circ$$

$$= \boxed{1.202 + j1.202\ \Omega}$$

2 pts If the motor can be modelled by a resistor and inductor in series, what are the values of R and L?

$$\boxed{R = 1.202\ \Omega}$$

$$j\omega L = j1.202 \Rightarrow \boxed{L = 3.19 \text{ mH}}$$