ECET 3500

Instructions: Show all of the calculations required to get the final answers for each problem, making sure that your work is legible and that your reasoning can be followed. Place all final answers in the spaces provided.

Express all final answers such that their magnitudes are rounded to three significant digits.

This assignment is to be completed individually without assistance from any other person (except the instructor).

Problem #1) A conductor that is **35mm** long is cutting orthogonally at a rate of **2.3m/s** across a uniform magnetic field that has a flux density of **0.88T**.
Determine the **voltage** potential developed across the conductor.
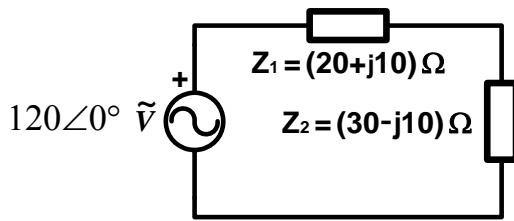
$V =$ _____ **V**

Problem #2) Determine the average **voltage** potential generated across a **50-turn** coil of wire that is linked with a **0.036 Wb** magnetic flux if the coil is removed from the flux such that the linked flux decreases to zero at a constant rate in **0.12 seconds**.

$V =$ _____ **V**

Problem #3) Determine the magnitude of the **force** acting on a conductor that is exposed to an orthogonally-oriented magnetic field with a flux density of **0.80 T** if the length of the conductor is **6.6 inches** and the conductor carries a DC current of **12.5 amps**.

$F =$ _____ **N**

Problem #4) Given the following steady-state AC circuit, determine the *total complex power*, S_{source}, produced by the source (expressed in rectangular form), the *power factor*, pf_{source}, of the source, and the *reactive power*, Q_{Z2}, consumed only by the impedance Z_2.

$Z_1 = (20+j10)\,\Omega$

$120\angle 0°\ \tilde{V}$

$Z_2 = (30\text{-}j10)\,\Omega$

$S_{source} =$ _____ $pf_{source} =$ _____ $Q_{Z2} =$ _____ VARs

Problem #5) A 3Φ source, with phase voltage $\tilde{V}_a = 277\angle 60°$ volts, is used to supply a 3Φ, Y-connected load, each phase of which has the impedance $Z_Y = 12 - j9\,\Omega$.
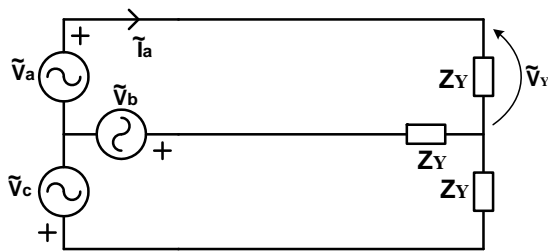
Determine the phasor values of all of the **phase voltages**, **line voltages**, and **line currents** produced by the source, and the **total complex power** produced by the source.

$\tilde{I}_a$

$\tilde{V}_a$ $\tilde{V}_b$

Z_Y $\tilde{V}_Y$

Z_Y

$\tilde{V}_c$

Z_Y

$\tilde{V}_a =$ _____**277∠60°**_____ V $\tilde{V}_{ab} =$ _____ V

$\tilde{V}_b =$ _____ V $\tilde{V}_{bc} =$ _____ V

$\tilde{V}_c =$ _____ V $\tilde{V}_{ca} =$ _____ V

$\tilde{I}_a =$ _____ A

$\tilde{I}_b =$ _____ A $S_{3\Phi} =$ _____

$\tilde{I}_c =$ _____ A

Problem #6) Motor "A" produces a maximum power of **300 hp** at **5500 rpm** while motor "B" produces a maximum power of **240 hp** at a **4000 rpm**. Determine the **torque** in foot·pounds (ft·lb) that each motor developes at the specified rotational speeds.

$$T_A = \text{\underline{\hspace{3cm}}} \quad \text{ft·lb}$$

$$T_B = \text{\underline{\hspace{3cm}}} \quad \text{ft·lb}$$

Problem #7) Determine the **rated torque** in inch·pounds for a **¼-horsepower**, **1670 rpm** motor.

$$T_{rated} = \text{\underline{\hspace{3cm}}} \quad \text{in·lb}$$

Selected Answers

1) $V = \underline{\quad 0.0708 \quad}$ V

2) $V = \underline{\quad 15.0 \quad}$ V

3) $F = \underline{\quad 1.68 \quad}$ N

4) $pf_{source} = \underline{\quad 1.00 \quad}$

   $Q_{Z2} = \underline{\quad -57.6 \quad}$ VARs

5) $S_{3\Phi} = \underline{\quad 12300 - j9210 \quad}$

6) $T_A = \underline{\quad 286 \quad}$ ft·lb

7) $T_{rated} = \underline{\quad 9.43 \quad}$ in·lb