ENGR 1990 Engineering Mathematics
Lab/Recitation #6 – 2D Vectors, Complex Numbers

1. Given a 200 (lb.) force $F$ that acts at an angle $\theta = -30^\circ$, and a line $L$ that passes through the points $A(3,4)$ and $B(10,7)$, complete the following. (a) Find a unit vector $\mathbf{n}$ that is parallel to line $L$. (b) Find the angle $\phi$ between $F$ and $L$. (c) Find $F_\parallel$ the component of $F$ parallel to $L$. (d) Find $F_\perp$ the component of $F$ perpendicular to $L$. Express the angle in degrees and radians and all vectors in terms of unit vectors $\mathbf{i}$ and $\mathbf{j}$.

2. A 500 (lb.) force $F$ acts at $C$ on the L-shaped bracket at an angle $\theta = 60^\circ$. (a) Find $M_A$ the moment of $F$ about $A$. (b) Find $d_A$ the perpendicular distance from $A$ to the line of action of $F$. (c) Find $M_B$ the moment of $F$ about $B$. (b) Find $d_B$ the perpendicular distance from $B$ to the line of action of $F$.

3. A voltage $v(t)=110\cos(120\pi t)$ volts is applied to the RL series circuit with $R=100\ \Omega$ and $L=500\ \text{mh}$. Given that the total impedance is $Z=Z_R+Z_L$, find
   a) $Z$ in both rectangular and polar form
   b) $I$ the complex current in both rectangular and polar form
   c) $i(t)$ the current as a function of time

4. A voltage $v(t)=110\cos(120\pi t)$ volts is applied to the RL parallel circuit with $R=100\ \Omega$ and $L=500\ \text{mh}$. Given that the equivalent impedance is $Z_{eq}=\frac{Z_RZ_L}{Z_R+Z_L}$, find
   a) $Z_{eq}$ in both rectangular and polar form
   b) $I$ the complex current in both rectangular and polar form
   c) $i(t)$ the current as a function of time

Impedances for AC circuit elements: $Z_R=R$, $Z_C=\frac{-j}{\omega C}$, and $Z_L=j\omega L$

Complex form of Ohm’s Law: $V=IZ$