ENGR 1990 Engineering Mathematics  
Lab/Recitation #5 – 2D Vectors

1. A force \( \mathbf{F} \) has a magnitude \( |\mathbf{F}| = 175 \text{ (lb)} \) and makes an angle \( \theta = 30 \text{ (deg)} \) with the \( X \) axis. Express the force \( \mathbf{F} \) in terms of the unit vectors \( \mathbf{i} \) and \( \mathbf{j} \).

2. A force \( \mathbf{F} \) has a magnitude \( |\mathbf{F}| = 175 \text{ (lb)} \) and makes an angle \( \theta = -120 \text{ (deg)} \) with the \( X \) axis. Express the force \( \mathbf{F} \) in terms of the unit vectors \( \mathbf{i} \) and \( \mathbf{j} \).

3. A force \( \mathbf{F} = -65 \mathbf{i} + 120 \mathbf{j} \) (lbs). Find the magnitude of \( \mathbf{F} \) and the angle between it and the \( \mathbf{i} \) direction. Express the angle in both degrees and radians.

4. A force \( \mathbf{F} = 58 \mathbf{i} + 75 \mathbf{j} \) (lbs). Find the magnitude of \( \mathbf{F} \) and the angle between it and the \( \mathbf{i} \) direction. Express the angle in both degrees and radians.

5. Given the three forces and angles \( |\mathbf{F}_1| = 165 \text{ (lbs)} \), \( \theta_1 = 30 \text{ (deg)} \), \( |\mathbf{F}_2| = 120 \text{ (lbs)} \), \( \theta_2 = 30 \text{ (deg)} \), and \( |\mathbf{F}_3| = 110 \text{ (lbs)} \), \( \theta_3 = 60 \text{ (deg)} \), find (a) the total force \( \mathbf{F} \) in terms of the unit vectors \( \mathbf{i} \) and \( \mathbf{j} \), (b) the magnitude of \( \mathbf{F} \), (c) the angle that \( \mathbf{F} \) makes with the \( \mathbf{i} \) direction, and (d) a unit vector in the direction of \( \mathbf{F} \).

6. Given a force \( \mathbf{F} = -100 \mathbf{i} + 80 \mathbf{j} \) (lbs) and a unit vector \( \mathbf{n} = \frac{4}{5} \mathbf{i} + \frac{3}{5} \mathbf{j} \), find (a) the angle between the two vectors, (b) \( \mathbf{F}_\parallel \) the component of \( \mathbf{F} \) parallel to \( \mathbf{n} \), and (c) \( \mathbf{F}_\perp \) the component of \( \mathbf{F} \) perpendicular to \( \mathbf{n} \). Express all vectors in terms of unit vectors \( \mathbf{i} \) and \( \mathbf{j} \).