## MATH 2415-0022- Calculus III - Spring 2019 Homework Assignment \# 2, Due Thursday, 31 January 2019

You do not need to print this assignment. Please write out complete solutions of each problem on your own paper, showing detailed work. Simplify answers to a reasonable degree, i.e., as is done in lecture. When complete, staple you assignment pages together and submit them to me at the beginning of the indicated class meeting.

1) For the three component vectors $\boldsymbol{u}=\langle 1,1,-2\rangle, \boldsymbol{v}=\langle-3,2,-1\rangle$, and $\boldsymbol{w}=\langle 2,5,0\rangle$, find the following quantities:
i) The vector $\boldsymbol{u}-3 \boldsymbol{v}+\frac{1}{5} \boldsymbol{w}$.
ii) The scalar $\boldsymbol{u} \cdot \boldsymbol{v}+\boldsymbol{u} \cdot \boldsymbol{w}+\boldsymbol{v} \cdot \boldsymbol{w}$.
iii) The vector $\boldsymbol{u} \times \boldsymbol{v}-\boldsymbol{v} \times \boldsymbol{w}$.
iv) The scalar $\boldsymbol{u} \cdot(\boldsymbol{v} \times \boldsymbol{w})$.
v) The vector $\boldsymbol{u} \times(\boldsymbol{v} \times \boldsymbol{w})$.
2) For the vectors $\boldsymbol{u}=3 \hat{\imath}+5 \hat{\jmath}-\widehat{\boldsymbol{k}}, \boldsymbol{v}=-\hat{\imath}+3 \hat{\boldsymbol{k}}$, and $\boldsymbol{w}=\hat{\boldsymbol{\imath}}-\hat{\boldsymbol{\jmath}}+\widehat{\boldsymbol{k}}$, find a unit vector in the direction of $\boldsymbol{v} \times \boldsymbol{w}$. If $\theta$ is the angle between $\boldsymbol{u}$ and $\boldsymbol{v} \times \boldsymbol{w}$, find an expression for the exact value of $\theta$. Use this expression to estimate the value of $\theta$ to the nearest hundredth of one radian, and to the nearest tenth of one degree.
3) Find two unit vectors that are mutually orthogonal to both of the vectors $\boldsymbol{u}=\langle-3,-1,2\rangle$ and $v=$ $\left\langle\frac{1}{2}, 1,-1\right\rangle$.
4) Use the scalar triple product to determine if the three points $P(6,4,3), Q(-1,-2,2), R(0,4,6)$, and $S(2,0,2)$ are coplanar, i.e., all four points lie in a single plane in $\mathbb{R}^{3}$. Hint: Consider the volume of the parallelepiped with the vectors $\overrightarrow{P Q}, \overrightarrow{P R}$, and $\overrightarrow{P S}$ as adjacent edges. In addition, find the area of the triangle $\triangle P Q R$, having vertices at $P, Q$, and $R$.
