Math. 302-06
Fall, 2018
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First Examination
Monday, September 10, 2018

Instructions: This exam should be done on your own paper. Your name should be on each sheet and on the back of the last sheet; the answers should appear written carefully and in order. If in doubt, show intermediate steps: Full credit may not be given, even for correct answers, unless work is arranged clearly and explained. This exam is closed book. You may leave after handing in your exam paper, but be sure to check your answers carefully. You may keep this exam sheet. Each part of each problem is worth 10 points, and 20 points are free.

1. Write down an equation for the plane through the points $P(1,1,1)$, $Q(0,2,0)$, and $R(0,0,3)$.

2. Consider $\vec{v} = \langle 1,1,1 \rangle$ and $\vec{b} = \langle -1,0,2 \rangle$.

   (a) Let $\vec{w}$ be the vector component of $\vec{v}$ in the direction of $\vec{b}$; compute $\vec{w}$.

   (b) Compute the vector component of $\vec{v}$ orthogonal to $\vec{b}$.

3. Determine the volume of the parallelepiped defined by the three vectors $\vec{u} = \langle 1,0,0 \rangle$, $\vec{v} = \langle 1,1,0 \rangle$, and $\vec{w} = \langle 1,1,1 \rangle$.

4. Write down an equation for the plane containing the following two lines, given in parametric form.

$$\begin{array}{rclrclrcl} x & = & t, & y & = & t, & z & = & t, \\ x & = & 2u-1, & y & = & -u, & z & = & -u. \end{array}$$

   (You may assume the lines lie in the same plane, in this case.)

5. Determine a point of intersection of the line with vector equation $\vec{r}(t) = \langle t-1, -t, 2t+1 \rangle$ with the plane with equation $2x - y + z = 3$.

6. Consider the rectangular coordinate equation $x^2 + y^2 + z^2 = x + y + z$.

   (a) Write down a corresponding equation in spherical coordinates.

   (b) Precisely describe the graph of this equation.