UP SCHOOL OF STATISTICS STUDENT COUNCIL
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EDUCATION AND RESEARCH

M54_LE3_002

Mathematics 54 **Elementary Analysis II**
Third Long Exam **1st Semester AY 2016-2017**

This exam is for 80 minutes only. Use black or blue non-erasable ink only. Show neat and complete solutions, and box all final answers. The use of electronic devices is not allowed during the exam.
Any form of cheating in examinations or any act of dishonesty in relation to studies, such as plagiarism, shall be subject to disciplinary action.

I. Write TRUE if the statement is always true. Otherwise, write FALSE. *[1 pt each]*

1. The projection of $\vec{a}$ onto $\vec{b}$ is parallel to $\vec{a}$.
2. The graph of the equation $z = x^2 + y^2$ is a hyperbolic paraboloid.
3. If two lines ℓ_1 and ℓ_2 do not intersect, then ℓ_1 is parallel to ℓ_2.
4. If $\vec{a} + \vec{b} = \vec{0}$ and $\vec{a} - \vec{b} = \vec{0}$, then $\vec{a} = \vec{b} = \vec{0}$.
5. If $\vec{u} \cdot (\vec{v} \times \vec{w}) = 0$, then $\vec{u} \times \vec{v}$ is orthogonal to $\vec{w}$.

II. Given the vectors

$$\vec{u} = \langle -1, 1, 2 \rangle,\ \vec{v} = \langle 6, 0, 3 \rangle,\ \vec{w} = \langle 0, 3, -4 \rangle$$

1. Show that $\vec{u}$ and $\vec{v}$ are orthogonal. *[2 pts]*
2. Find the vector of length 3 with direction opposite to the direction of $\vec{w}$. *[2 pts]*
3. Find the volume of the parallelepiped defined by the vectors $\vec{u}$, $\vec{v}$, and $\vec{w}$. *[3 pts]*

III. Given a point $P(2, 1, -1)$ two lines $\ell_1 : \begin{cases} x = 3 + t \\ y = 2 + t \\ z = -6 - 2t \end{cases}$ and $\ell_2 : \dfrac{x+2}{3} = y + 1 = \dfrac{z-2}{-4}$.

1. Find the equation (in center-radius form) of the sphere centered at P and passing through the point on ℓ_1 with x-coordinate equal to 0 *[3 pts]*
2. Find the point of intersection of ℓ_1 and ℓ_2. *[3 pts]*
3. Find the distance between P and ℓ_1. *[4 pts]*

IV. Consider the planes $\pi_1 : 2x - y + 3z + 5 = 0$ and $\pi_2 : x + 2y - 2z - 4 = 0$, and the point $Q(0, 7, -4)$.

1. Find an equation of the plane passing through Q and perpendicular to π_1 and π_2. *[3 pts]*
2. Find symmetric equations of the line passing through Q and perpendicular to π_1. *[2 pts]*
3. Find the distance between Q and π_2. *[2 pts]*

V. Consider the equation $z = x^2$

1. Sketch the portion of the cylinder with the given equation in the first octant. *[2 pts]*
2. Let C be the curve in the xz-plane with the given equation. Find an equation of the surface of revolution obtained by revolving C about the z-axis. *[2 pts]*

VI. Given the quadric surface with equation $4 - z = \dfrac{x^2}{4} + \dfrac{y^2}{9}$.

1. Find the equation of the traces on the xy-, xz-, and yz-planes. Identify these traces. *[3 pts]*
2. Identify the surface. *[1 pt]*
3. Sketch the graph of the surface. Label important points on the graph. *[3 pts]*

END OF EXAM
TOTAL: 40 points