EXAMINATION: Engineering Mathematical Analysis 1 | TIME: 75 minutes

COURSE: MATH 2130 | EXAMINER: Harland

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[3] 1. (a) For the curve, $y = -x^2 - z^2$, identify the type of curve and give a sketch.

[5] (b) Determine the projection of $x^2 + y^2 - 4z^2 = 1,\ x + y = 2$ in the xz-plane.

2. Let l_1 be the line

$$\frac{x-1}{3} = y - 2 = \frac{z-3}{5}$$

and l_2 be the line

$$x = -1 - 2t,\ y = 8 + t,\ z = 9 - t.$$

[3] (a) Show that the lines are intersecting and find the point of intersection.

[5] (b) Determine the equation of the plane containing both lines.

[3] (c) Calculate the distance from the point $R(1, 2, -3)$ to the plane found in part (b).

3. Let l_1 be the line

$$\frac{x-3}{2} = \frac{y+5}{3} = \frac{z-1}{-2}$$

and l_2 has parametric equations

$$x = 1 + 2t, \quad y = 3 \quad z = 1 + 3t.$$

[5] (a) Determine whether the lines are parallel, intersecting or skew.

[6] (b) Calculate the shortest distance between the lines.

[6] 4. Find a parametric representation for the curves of intersection of $x^2 + y^2 = z^2$ and $x^2 + y^2 + z^2 = 18$ directed so that x increases when y is positive. Justify your answer. Assume $z \geq 0$.

5. Let a curve C be defined by a position vector $\mathbf{r_1}(t) = (3 - 2t^2,\ t,\ 2 - t)$ and let a curve D be defined by a position vector $\mathbf{r_2}(s) = (s^3,\ s,\ s^2)$.

[4] (a) Determine parametric equations for the tangent line to $\mathbf{r_1}(t)$ at the point (3, 0, 2).

[6] (b) Determine the point of intersection of the two curves and find the cosine of the angle between the curves at that point.

[4] (c) Set up, but don't evaluate an integral to find the length of the curve C from the point (3, 0, 2) to (−5, 2, 0).