1) For the line and the plane given by $x = 3 - t$, $y = t + 1$, $z = 3t$ and $x + y - z = 1$

a) Determine the coordinates of the point of intersection of the line and the plane

b) Determine the cosine of the angle between the line and a line normal to the given plane

2) For the space curve $x = t + 1$, $y = \sqrt{2t + 1}$, $z = (t^2 - 4)$

a) Determine the equation of the line tangent to the curve at $t = 1$

b) Determine the acceleration vector at $t = 1$

3) Find all the relative and absolute extrema of the function

$f(x, y) = x^2 + 3y - 3xy$ bounded by the region $y = x$, $y = 0$, $x = 2$

4) Using Lagrange multipliers find the maximum and minimum values of the function

$f(x, y) = xe^y$ subject to the constraint $x^2 + y^2 = 2$

5) a) Determine the directional derivative of $f = e^{xy+z}$ at the point $(1,-1,1)$

b) Determine the equation of the plane tangent to the surface $e^{xy+z} = 1$

at the point $(1,-1,1)$

6) For the conservative vector field $F = 2xyi + (x^2 - t)j$

determine its potential $f(x, y)$ and evaluate the line integral $\int_{(3,1)}^{(1,0)} F \cdot dr$.

7) Use the corollary of Green's Theorem to evaluate the area enclosed between the curves

$y = x^2$ and $y = 4$ as a line integral (Hint: $Area = \int xdy$)

8) Use Green’s Theorem, for the vector field $F = (y^3 - \ln x)i + (\sqrt{y^2 + 1} + 3x)j$, to evaluate the line integral $\int F \cdot dr$ over the boundary of the region formed by the curves $x = y^2$ and $x = 4$, as a double integral over this region, oriented counter clockwise.

9) Using the Divergence Theorem evaluate $\iint_S F \cdot n dS$, as a triple integral over

the region enclosed by the paraboloid $z = 4 - x^2 - y^2$ and the plane $z = 0$ for the vector field $F = x^2i + y^3j + z^3k$

10) Use Stokes Theorem to evaluate the circulation $\int_c F \cdot dr$, as a surface integral, for

$F = -yi + x^2j + z^3k$ around the curve which is the boundary of the ellipse cut from

the cylinder $x^2 + y^2 = 4$ by the plane $x + z = 3$, counter clockwise when viewed from above.