I. (15%) A helix is described by the equation
\[ \mathbf{r}(t) = (4 \sin t, 4 \cos t, 3t). \]

a) Find \( \mathbf{r}'(t) \) and \( \mathbf{r}''(t) \).

b) Find the length of the curve when \( 0 \leq t \leq \pi \).

c) Find the curvature at the point \( t = 0 \).
II. (15%) A helix is described by the equation
\[ \vec{r}(t) = (4 \sin t, 4 \cos t, 3t). \]

a) Find the tangent vector \( \vec{T} \) at the point \( t = 0 \).
b) Find the normal vector \( \vec{N} \) at the point \( t = 0 \).
c) Find the binormal vector \( \vec{B} \) at the point \( t = 0 \).
III. (15%) A helix is described by the equation

\[ \vec{r}(t) = (4 \sin t, 4 \cos t, 3t). \]

a) Find the equation of the normal plane at \( t = 0 \).
b) Find the equation of the osculating plane at the point \( t = 0 \).
c) Find the angle between the helix and the line \( \vec{r}(s) = (s, s + 4, -s) \) at the point \( (0, 4, 0) \).
IV. (15 \%) The motion of the particle is described by the equation

\[ \vec{r}(t) = (4 \sin t, 4 \cos t, 3t). \]

a) Find the velocity and the acceleration as functions of time.

b) Find the speed at \( t = 0 \).

c) Find the tangential and normal component of acceleration at \( t = 0 \).
V. (10%) Find the integral $\int_0^1 (5\vec{i} - 2t\vec{j} + t^2\vec{k})dt$.

VI. (10%) Let $f(x, y) = x^2 + 3yx^3$. Find $f_x, f_y, f_{xx}, f_{yy}, f_{xy}$. 
VII (20%). Let $f(x, y) = x^2 + y^2$.

a) Find the equation of the tangent plane to the surface $z = x^2 + y^2$ at the point (2, 1).
b) Find the linearization of the function $f(x, y) = x^2 + y^2$ at the point (2, 1).
c) Use the linearization to find an approximate value of the function at the point (2.2, 1.3).
d) Find the formula for $dz$ at the point (2.1).