(1) An equation is $\boxed{\vec{r}(t) = t\langle 3,3,3\rangle + (1-t)\langle 1,-1,2\rangle}$ $\boxed{0 \le t \le 1}$

an alternative form is $\boxed{\vec{r}(t) = \langle 1,-1,2\rangle + t\langle 2,4,1\rangle, 0 \le t \le 1}$

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(2) $\vec{r}'(t) = \langle 1, 2t, 3t^2\rangle$, so $\vec{r}'(1) = \langle 1,2,3\rangle$.

$\vec{r}(1) = \langle 1,1,1\rangle$, so an equation for the tangent line is:

$\vec{s}(t) = \langle 1,1,1\rangle + t\langle 1,2,3\rangle$. Parametric equations are thus

$$\boxed{\begin{aligned} x(t) &= 1+t \\ y(t) &= 1+2t \\ z(t) &= 1+3t \end{aligned}}$$

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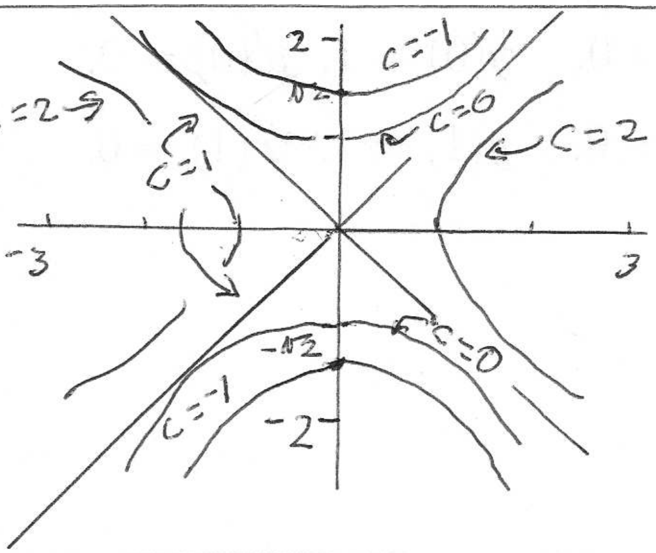
(3) 

$\boxed{\begin{aligned} c=-1:\ & x^2-y^2=-2 \\ & y^2 = x^2+2 \end{aligned}}$

$\boxed{c=0: x^2-y^2=-1}$

$\boxed{c=1: x^2-y^2=0}$

$c=2: x^2-y^2=1$

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(4) $\dfrac{\partial f}{\partial x} = e^{xyz} + xyze^{xyz} = (1+xyz)e^{xyz}$

$\dfrac{\partial f}{\partial y} = x^2ze^{xyz} + z^2$

$\dfrac{\partial f}{\partial z} = x^2ye^{xyz} + 2yz$

5 $f(0.9, 2.1, 3.1) \approx f(1,2,3) + f_x(1,2,3)(-.1) + f_y(1,2,3)(.1)$
$+ f_z(1,2,3)(.1)$
$\approx 4 + (-1)(-.1) + 2(.1) + 1(.1)$
$= 4 + .1 + .2 + .1 = \boxed{4.4}$.

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6 Set $F(t) = f(x(t), y(t), z(t))$.
Then $\frac{dF}{dt} = \frac{\partial f}{\partial x}\frac{dx}{dt} + \frac{\partial f}{\partial y}\frac{dy}{dt} + \frac{\partial f}{\partial z}\frac{dz}{dt} = \nabla f \circ \langle x', y', z' \rangle$
$= (2xy + z^2)(1) + (x^2 + 2yz)(2t) + (y^2 + 2zx)(3t^2)$.
Since $\vec{r}(1) = \langle 1, 1, 1 \rangle$, we have
$\left.\frac{dF}{dt}\right|_{t=1} = (2+1)(1) + (1+2)(2) + (1+2)(3)$
$= 3[1+2+3] = 3(6) = \boxed{18}$
