1. (13%) Evaluate $\iint_\Omega (x-y)^{20}\,dA$, where Ω is the parallelogram enclosed by $2x+y=0$, $2x+y=1$, $x+2y=0$ and $x+2y=1$.

2. (12%) Evaluate
$$\iint_\Omega e^{-(x^2+y^2)}\,dA, \qquad \Omega=\{(x,y): 1\le x^2+y^2\le 2,\ y\ge 0,\ y\ge x\ge -y\}.$$

3. (13%) Find the points on the curve $10x^2+12xy+5y^2=14$ that are closest to and farthest from $(0,0)$.

4. (12%) Given a function $f(x,y)$ in two variables x, y, consider the function $g(t)=f(1+2t,3+4t)$. Express $g'(0)$ and $g''(0)$ in terms of $\frac{\partial f}{\partial x}(1,3)$, $\frac{\partial f}{\partial y}(1,3)$, $\frac{\partial^2 f}{\partial x^2}(1,3)$, $\frac{\partial^2 f}{\partial x\partial y}(1,3)$, $\frac{\partial^2 f}{\partial y^2}(1,3)$.

5. (12%) Find an equation for the tangent plan to the surface $xe^{yz}+\ln(y^3z^2)=\tan^{-1}\left(\frac{x}{z}\right)$ at the point $(0,1,1)$.

6. (13%) Let $f(x,y)=\left(\frac{x^2}{4}+y^2-1\right)^2+x^2y^2$.
   (a) Find $\nabla f(2,1)$.
   (b) Find $\frac{\partial f}{\partial \vec{u}}(2,1)$, where $\vec{u}$ is the unit vector in the direction of the vector $(3,1)$.
   (c) Find the unit vector $\vec{u}$ such that $\frac{\partial f}{\partial \vec{u}}(2,1)$ attains its maximum. Also find this maximum.
   (d) Find the equation of the tangent line to the level curve of $f(x,y)$ through the point $(2,1)$ at the point $(2,1)$.

7. (13%) Find the critical points of $f(x,y)=e^{y^2-x^2}(y^2+x^2)$ and determine it is local maximum, local minimum or saddle points.

8. (12%) Find $\iint_\Omega \frac{\sin x}{x}dA$ where Ω is the triangle in the xy-plane bounded by the x-axis, the line $y=x$, and the line $x=1$.