The final will cover from Chapter 12 to 15.
There will be an extra review at 4:10pm Sunday December 15.

1. Find the tangent plane of $xu(x, y)+y(u(x, y))^2 = 2x^2$ at the point $(1, 1, 1)$.
Find the tangent plane of $x^2 + y^2 + 2z^2 = 4$ at $(1, 1, 1)$.
2. Plot level curves for the function
$z = f(x, y) = 4x^2 + y^2$.
Plot the level surfaces of the function $f(x, y, z) = x^2 + y^2 + 4z^2$.
3. Find the direction in which the function $z = 2x + \sin(2y - x)$
increases the most from the point $(0, 0)$.
4.Find the directional derivative of $z = f(x, y) = 4x^2 + y^2$
in the direction of i+j at the point $(1, 1)$.
What is physical meaning of this derivative?
5. Compute: $(x^y)_{xy}$.
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6. Find tangent, normal vector and curvature of the curve:
ti+tj+t^2 k.
7. A particle's acceleration is according to
$a(t) = \sin t$ i$-t$ j+t^2 k. Find all its
possible vector-valued position function.
8. Find parametrizations of the curves $4x^2 + y^2 = 1$ and $\frac{1}{4}x^2 + y^2 = 1$.
9.Find maxima and maximal value of the function $2x - y$ inside the unit circle.
10. Find the integral $\int\int\int_D x^2 dvol$, where D is the upper half unit ball
$x^2 + y^2 + z^2 \leq 1$, $z \geq 0$.

11. Find maxima and maximal value of the function $x^2 + 2y$ in the triangle
$x + 3y = 1, y = 0$ and $x = 0$.
12. Find the integral $\int\int\int_D x dvol$, where D is the part of the unit ball
$x^2 + y^2 + z^2 \leq 1$ and $x \geq 0, y \geq 0, z \geq 0$.

13. Find the extrema of the function x^2y in the triangle bounded by the $x - axis$
and $y - axis$ and the line $x + y = 1$.
14. Compute $\int\int_D x^2 y dx dy$, where D is the upper half disk.
15. Compute the divergence and curl of the vector fields x^2yi+$\cos(x + y)$j+zk. The physical meaning of divergence is the density of the source of the vector field and that for curl is the vector valued circulation density.

16.Compute $\int_C yx dx + x dy$,where C is the counterclockwise unit circle.

17. Compute $\int_S x^2 ds$, where S is the upper half circle.
18. Compute the center of mass of unit circle with density $d(x, y) = x^2$.

19. Write down the change of variable formulae for

spherical and cylindrical coordinates.

20. Compute the integral
$\int\int_{x^2+4y^2\leq 4}(x+y^2)dxdy$.

21.Compute $\int\int_{\Sigma} F \bullet n dS$ where Σ is the region bounded by the upper half sphere
and $F = xy^2$i+$(x+y)$j+zk.

22. Compute $\int_C F \bullet dr$, where $F = x^2y$i+$(x+y)$j+zk and C is the intersection of the unit sphere and the plane $x = z$, with the right hand orientation.
23. Compute $\int\int_{\Sigma} FdS$ where Σ is the region bounded by the upper half sphere
and $F = z$.

24. Approximate $\sqrt{99}$ and $\sin(46^o)$. You have to show the formula. An answer
from calculate will yield 0 point.
25. Find the maximum of xyz if $x+y+z=1$ and positive.