Math 20550 - Calculus III
Final Review

This list includes the previous 3 lists.

16. Vector Calculus

16.5. **Curl and Divergence.**

- Given a vector field $\mathbf{F}$, know the definitions of and how to compute div $\mathbf{F}$ and curl $\mathbf{F}$
- Know the relations between div , grad , and curl (i.e., div curl $\mathbf{F} = 0$ and curl grad $\mathbf{F} = \mathbf{0}$).

16.6. **Parametric Surfaces and Their Areas.**

- Be able to parametrize a surface
- Be able to find the tangent plane to a parametrized surface
- Remember that the surface area of a surface is given by $\displaystyle\iint_S dS$

16.7. **Surface Integrals.**

- Be able to compute the surface integral $\displaystyle\iint_S f(x, y, z)dS$ (remember that $dS = |\mathbf{r}_u \times \mathbf{r}_v|dA$ for any parametrization $\mathbf{r}(u, v)$, $(u, v) \in D$, of S).
- In the case that S is the graph of a function $g(x, y)$, i.e., S is given by the equation $z = g(x, y)$ for (x, y) in D, then you can use
$$\iint_S f(x, y, z)dS = \iint_D f(x, y, g(x, y))\sqrt{(g_x)^2 + (g_y)^2 + 1}\; dA$$
- Know how to compute the mass and center of mass of a surface given its density function
- Know what an orientation on a surface is
- Know how to find the correct orientation on a surface
- Be able to compute a flux integral $\displaystyle\iint_S \mathbf{F} \cdot d\mathbf{S}$ given an orientation on the surface S
- In the case that S is the graph of a function $g(x, y)$, i.e., S is given by the equation $z = g(x, y)$ for (x, y) in D, and S is given the *upward orientation* then you can use
$$\iint_S \mathbf{F} \cdot d\mathbf{S} = \iint_D (-Pg_x - Qg_y + R)\, dA$$
where $\mathbf{F} = \langle P, Q, R\rangle$.

16.8. **Stokes' Theorem.**

- Given an oriented surface S with boundary C, know how the orientation on S induces an orientation on C
- Given a surface S with boundary C, and a choice of orientation for C, be able to choose the correct orientation for S
- Know the statement of Stokes' theorem. Especially keep in mind the orientation hypothesis
- Be able to use Stokes' theorem to compute line/flux integrals
- Know how to use Stokes' theorem to switch the surface of integration

16.9. **The Divergence Theorem.**

- Know the statement of the Divergence Theorem. Especially keep in mind the orientation hypothesis
- Be able to use the divergence theorem to compute flux integrals over closed surfaces
- Know how to use the divergence theorem to compute flux integrals over non-closed surfaces (this invloves "capping off" the surface. c.f., exercises 17 and 18 in section 16.9)