Final Exam Formulae

The following formulae will be provided during the final exam. You are expected to have learned or memorized anything we covered in this course that is not included on this sheet. You are also expected to remember the hypotheses of the theorems listed here and the ways in which these formulae are used.

**Fundamental Theorem for Line Integrals**

\[ \int_C \nabla f \cdot d\vec{r} = f(\vec{r}(b)) - f(\vec{r}(a)) \]

**Green’s Theorem**

\[ \int_C P \, dx + Q \, dy = \int\int_D \left( \frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) \, dA \]

**Surface Integral of a Scalar Function**

\[ \int\int_S f(x, y, z) \, dS = \int\int_D f(\vec{r}(u, v)) \left| \vec{r}_u \times \vec{r}_v \right| \, du \, dv \]

**Surface Integral of a Vector Field**

\[ \int\int_S \vec{F} \cdot d\vec{S} = \int\int_D \vec{F}(\vec{r}(u, v)) \cdot (\vec{r}_u \times \vec{r}_v) \, du \, dv \]

**Stoke’s Theorem**

\[ \int_C \vec{F} \cdot d\vec{r} = \int\int_S \text{curl} \, \vec{F} \cdot d\vec{S} \]

**The Divergence Theorem**

\[ \int\int_S \vec{F} \cdot d\vec{S} = \int\int\int_E \text{div} \, \vec{F} \, dV \]

**Polar/Cylindrical Coordinate Conversion**

\[ x = r \cos \theta \quad y = r \sin \theta \]

**Spherical Coordinate Conversion**

\[ x = \rho \sin \phi \cos \theta \quad y = \rho \sin \phi \sin \theta \quad z = \rho \cos \phi \]