MTH 212 - MULTIVARIATE CALCULUS - STUDY GUIDE FOR FINAL EXAM

No books, lecture notes, calculators, cell phones, or other electronic devices are permitted during the test!

Use notes, text, homework, and suggested exercises to prepare for the test.

During the final exam, you are allowed to use a formula sheet provided by the instructor.

Note that it is a cumulative exam that covers all the material described in Study Guides for Exams I-IV (about 2/3 of the test), and the material from Sections 15.2 - 15.8 (about 1/3 of the test).

Topics since Exam IV (some formulas will be provided on a formula sheet - make sure to check it):

- Section 15.2 *Vector Fields, Work, Circulation, and Flux.*

  Given a vector field $\mathbf{F}$ and a curve C, parameterized by $\mathbf{r}(t)$, $a \le t \le b$, use a line integral to calculate:

  - **flow/work** of $\mathbf{F}$ along or **circulation** around C:
    $\int_C \mathbf{F} \cdot \mathbf{T}\, ds = \int_C \mathbf{F} \cdot d\mathbf{r} = \int_a^b \mathbf{F}(\mathbf{r}(t)) \cdot \frac{d\mathbf{r}}{dt}\, dt$.
  - **flux** of $\mathbf{F} = M\mathbf{i} + N\mathbf{j}$ across C in the plane: $\int_C \mathbf{F} \cdot \mathbf{n}\, ds = \oint_C M\, dy - N\, dx$
    $= \int_a^b (M\frac{dy}{dt} - N\frac{dx}{dt})dt$.

- Section 15.3 *Path Independence, Conservative Fields, Potential Functions.*

  Conservative vector fields: know the definition, the component test, how to find the potential function, how to evaluate lines integrals using the fundamental theorem of line integrals.

- Section 15.4 *Green's Theorem in the Plane.*

  Know the definitions of circulation density (or $\mathbf{k}$-component of the curl) and divergence (or flux density).
  2D problems using Green's theorem: know two formulations (one for circulation and one for flux) and use them for:

  - turning a line integral along a plane curve into a double integral over the interior of the curve;
  - finding circulation and flux.

- Section 15.5 *Surfaces and Area.*

  Know how to parameterize basic surfaces or their portions (spheres, cones, planes, cylinders). (Any complicated parameterizations and figures will be provided.)
  Ignore implicitly defined surfaces.
  Know how to compute surface area of a parameterized surface.

- Section 15.6 *Surface Integrals.*

  Know how to integrate a function over a surface (no implicitly defined surfaces).
  Know how to compute flux of a vector field across a smooth oriented surface using a surface integral.

- Section 15.7 *Stokes' Theorem.*

  Know how to set up both sides of the equation - one line integral along the boundary of a surface, one surface integral.

- Section 15.8 *Divergence Theorem.*

  Know how to set up both side of the equation - one surface integral, one triple integral over a solid.