MA 261 Final Exam Study Guide

The Final Exam is cumulative. As such, it will cover most of the material from the entire course.

The final exam will be worth 200 points. There are 8 multiple choice questions and 12 free response questions. There is no partial credit for multiple choice questions, but partial credit may be awarded for free response questions. You must show all of your work for full credit on the free response questions.

You should be able to do every homework question. Calculators are not allowed on the exam, so the computations will be simple enough to do by hand.

**Topics to know:**

- The geometry of 3-space: vectors, dot product and its applications (finding angle between vectors, etc.), cross product and its applications (finding vector orthogonal to two vectors, finding area of parallelogram, etc.), equations of spheres, equations of lines (find the equations of lines satisfying certain criteria, e.g., the line of intersection of two planes), equations of planes (find the equations of planes satisfying certain criteria, e.g., the plane containing three given points), cylinders (identify), quadric surfaces (identify: you will *not* be given the table – you must know how to identify the quadric surfaces)
- Vector functions and space curves: derivatives of vector functions and tangent vectors, find arc length, find curvature, understand how position, velocity, and acceleration are related through vector functions and be able to find one given the others.
- Functions of several variables: find domains, identify level curves and match contour plots, understand/compute limits of multivariate functions if they exist and be able to tell when a limit does not exist by finding different values along different lines $y = mx$ or curves such as $y = x^2$, be able to identify where a function is continuous.
- Derivatives: compute partial derivatives, know Clairaut's Theorem, find the equation of a tangent plane, find a linear approximation, know how to use the chain rule for multivariate functions, compute directional derivatives and know what they mean, compute the gradient vector, know how to find the direction of maximal increase or decrease of a function and how it relates to the gradient.
- Optimization: know how to find critical points, understand local extrema using the second derivatives test (it will *not* be provided to you), finding absolute extrema on a closed bounded region by evaluating the function at the boundaries, finding absolute extrema of a function subject to a constraint by using the Method of Lagrange Multipliers
- Double integrals: setting up a double integral as an iterated integral in either order of integration, computing an iterated integral, switching the order of integration of a double integral, using a double integral to compute the area of a region $D$ in the $xy$-plane,

converting a double integral from rectangular to polar coordinates, setting up a double integral in polar coordinates

- Applications of double integrals: Finding the mass and centroid of a lamina with variable density, finding the surface area of a surface $z = f(x, y)$ over a region $D$ in the $xy$-plane.
- Triple integrals: setting up triple integrals as iterated integrals in all six orders of integration, computing an iterated integral, switching the order of integration of a triple integral, using triple integrals to compute the volume of a region $E$ in $\mathbb{R}^3$, converting a triple integral from rectangular to cylindrical coordinates, setting up a triple integral in cylindrical coordinates, converting a triple integral from rectangular to spherical coordinates, setting up a triple integral in spherical coordinates
- Line integrals: computing the line integral of a function along a curve using the definition, computing the line integral of a vector field along a curve using the definition or the Fundamental Theorem for Line Integrals or Green's Theorem or Stokes' Theorem, find the work done by a vector field on an object moving along a smooth curve $C$.
- Divergence and curl: compute divergence and curl of vector fields. Understand how div, curl, and grad convert scalar/vector fields into scalar/vector fields, and whether certain operations involving div and curl are meaningful or meaningless. Know how div and curl can tell you information about vector fields (such as if they are conservative)
- Parametric surfaces: identify a surface given a parameterization, find a parameterization of a surface, find surface area of a parametric surface
- Surface/flux integrals: computing surface integrals of a function over a surface using the definition, computing the surface integral of a vector field along a surface using the definition or using Stokes' Theorem (to convert into a line integral or to switch the surface for a nicer one, if you know that your vector field is the curl of some vector field) or using the Divergence Theorem, find the flux of an electric field across a surface

There is no way that every single one of these topics could be covered on the exam. There will be some sections of the textbook which are completely skipped over on this exam. Please be aware of this.

You should be capable of doing every homework problem (even the ones which are too long and/or difficult to be placed on an exam – you can still be asked how to do parts of these problems, even you aren't asked to do the full problem).

The following formulas will be provided to you, if you need them:

$$\sin^2\theta = \frac{1}{2}(1 - \cos 2\theta)$$

$$\cos^2\theta = \frac{1}{2}(1 + \cos 2\theta)$$

Antiderivatives of tricky functions such as $\sec x$ or $\sec^3 x$

**Practice Problems you can do, if you want:**

Chapter 12 Review (pages 842-843)

Exercises: 1, 5, 11, 16, 24(for b, just find the exact value in radians – don't round), 25, (for the following problems, just identify, don't sketch): 28-36

Chapter 13 Review (pages 882-883)

Exercises: 2.a,c, 8, 12, 19

Chapter 14 Review (pages 982-984)

Exercises: 2, 5, 9, 10, 16, 20, 26.a, 33(don't worry about messy numbers), 35, 40, 46, 47, 53(don't worry about graphing), 56, 61

Chapter 15 Review (pages 1062-1063)

Exercises: 6, 9, 10, 19, 27, 32, 34, 40, 41.a,b, 53

Chapter 16 Review (pages 1149-1150)

True-False Quiz: 1, 2, 3, 9, 10

Exercises: 3, 13, 14, 17, 18, 25, 28, 30, 32, 33, 34, 37, 39