MATH 126 FINAL EXAM GUIDE Exam date, Saturday March 16, 5-7:50pm Kane 110

Exam Rules:

1. Your exam should consist of this cover sheet, followed by 8 problems. Check that you have a complete exam.
2. Pace yourself. You have 2 hours and 50 minutes to complete the exam.
3. Unless otherwise indicated, show all your work and justify your answers.
4. You may use one 8.5×11-inch sheet of handwritten notes and a TI-30X IIS scientific calculator for computation. All other electronic devices are strictly forbidden.
5. Unless otherwise indicated, your answers should be exact values rather than decimal approximations. (For example, $\pi/4$ is an exact answer and is preferable to its decimal approximation 0.7854.)
6. You are not allowed to use scratch paper. If you need more room, use the back of the page and indicate to the reader that you have done so.
7. *TURN OFF YOUR PHONE AND PUT IT OUT OF SIGHT!* If the proctor sees or hears a phone during the exam, you will be asked to surrender either the phone or your exam.
8. The use of headphones or earbuds during the exam is not permitted.
9. Cheating is a hassle for everyone involved. DO NOT CHEAT. If you are caught cheating, you will be given a zero on the exam and reported to the academic disciplinary board
10. You may be asked to present a photo ID at any point during the exam. If you do not have one, then you will be asked to surrender your exam.

Exam Structure: The final exam will consist of 8 questions with two questions generally associated with each of the following 4 topics in the order given:

Questions 1-2: Chapters 12 and 13 (vectors and vector functions)

Questions 3-4: Chapter 14 (partial derivatives, tangent planes, optimization, linear approximation)

Questions 5-6: Chapter 15 (double integrals, including at least one integral involving polar coordinates)

Questions 7-8: Taylor Notes (Taylor polynomials and approximation bounds, Taylor series)

Notes:

1. It is important to note that although the questions are written to address particular topics, the question writers are encourages to write questions that span/synthesize multiple topics/sections/chapters.
2. The questions should be written to span a range of difficulty, so maybe one easy/medium question and one harder question or the questions could have multiple parts with various levels of difficulty.
3. The past few finals in the exam archive are reviewed so that the exam is not asking the same questions over and over. Nonetheless, these exams provide a wonderful study guide for the types of questions and the level of difficult.
4. The questions are mindful of the fact that it is the homework that all of the students have in common so the homework is the guide for notation and vocabulary.

Basic skills list for the 126 Final Exam

The following is a collection of some of the things you are expected to be able to do on the final exam. It is intended as a starting point, not as a comprehensive summary of the course: review all lectures, reading materials, and homework problems to get the complete picture. You are also expected to be able to combine these skills to solve new problems.

It is essential that you practice these skills. Re-do old homework problems, do old midterms, do provided review problems. Practice, practice, practice.

1. Vector basics. You should be able to determine or find:
   (a) the magnitude of a vector
   (b) the dot product of two vectors
   (c) the cross product of two vectors (d) the angle between two vectors
   (d) whether or not two vectors are parallel
   (e) whether or not two vectors are perpendicular
   (f) vector and scalar projections of a vector onto another
2. Lines, planes, and points in 3D. You should be able to determine or find:
   (a) the center and radius of a sphere given by its equation
   (b) the point of intersection of two lines
   (c) the line of intersection of two planes
   (d) the equation of a line passing through two given points
   (e) the equation of a plane passing through three given points
   (f) the equation of a plane passing through a point, parallel to a given plane
   (g) the equation of a plane containing a line and a given point
   (h) the angle between two intersecting planes
   (i) the angle between two intersecting lines
   (j) whether or not a point is part of a given line, or a given plane
   (k) whether or not a line is part of a given plane
   (l) whether or not two planes intersect or are parallel
   (m) whether or not two lines intersect or are parallel
   (n) whether or not two sets of equations define the same, or different, lines or planes
3. Cylinders and Quadric Surfaces. You should be able to:
   (a) Identify a quadric surface from its equation
   (b) Identify a cylinder given its equation (i.e., be able to tell that is is a cylinder)
   (c) Identify a quadric surface from a sketch of one
   (d) describe the traces of a surface given its equation
   (e) find the equation of a quadric surface given an English description of the points on the surface
4. Vector functions, space curves, and motion. You should be able to:
   (a) sketch/identify the curve defined by a vector function $\vec{r}(t)$.
   (b) find tangent vectors and tangent lines to a vector function $\vec{r}(t)$
   (c) find points of intersection of two parametric curves or a parametric curve and a surface
   (d) give a parameterization of the intersection of two surfaces
   (e) compute the arc length of (a piece of) a curve defined by $\vec{r}(t)$
   (f) re-parameterize a curve with respect to arc length
   (g) compute curvature and radius of curvature

(h) find unit tangent and unit normal vectors

(i) solve problems involving position, velocity, speed and acceleration of an object moving along the curve defined by $\vec{r}(t)$

5. Polar coordinates. You should be able to:

   (a) convert between polar and Cartesian coordinates

   (b) find the Cartesian equation of a curve defined using polar equations, and vice versa

   (c) sketch/identify a curve defined by a simple polar equation

6. Two-variable functions. You should be able to:

   (a) draw and interpret level curves and contour maps of a function $z = f(x, y)$

   (b) find and sketch the domain of a function $z = f(x, y)$

   (c) compute and interpret partial derivatives (including by implicit differentiation)

   (d) find the equation of a tangent plane to a function $z = f(x, y)$

   (e) use linear approximation to approximate a specific value of a function $z = f(x, y)$

   (f) find all critical points and use the Second Derivative Test to classify the critical points of a function $z = f(x, y)$

   (g) find the global optima of $f(x, y)$ on a closed, bounded region

   (h) set up and solve applied optimization problems involving functions of two variables.

7. Double Integrals. You should be able to:

   (a) approximate double integrals using Riemann sums

   (b) compute and interpret double integrals in Cartesian and polar coordinates

   (c) reverse the order of integration in a double integral

   (d) compute mass and center of mass of a two-dimensional lamina with variable density

8. Taylor Series. You should be able to:

   (a) find the Taylor polynomial of any specified degree of a given function

   (b) determine a bound on the error between a function and one of its Taylor polynomials on a specified interval

   (c) determine an interval on which the error between a function and one of its Taylor polynomials is below some given bound

   (d) find the degree of the Taylor polynomial needed to achieve a specified degree of accuracy in approximating a given function on a given interval

   (e) determine the Taylor series of certain functions from the definition of a Taylor series

   (f) use substitution, differentiation, integration, series addition, and multiplication by powers of $(x?b)$ to create Taylor series from known series

   (g) determine the n-th derivative at b of a given function by first finding the functions Taylor series

Material NOT on Final Exam

Topics NOT on the final:

- **binormal vectors,**
- **normal planes,**
- **osculating planes,**
- **tangent lines to polar curves,**
- **differentials,**
- **center of mass computations and**
- **average value of a function.**

Here is a list of problems from old final exams that you should skip during your preparation for the final since they cover material that some sections did not cover this quarter. Also skip all problems involving center of mass computations.

Notation: W15 = Winter 2015 and F11= Fall 2011

W17	1b, 2b
F16	5
S16	4
W16	3a
F15	6b, 7c
S15	3, 4b
W15	3c (last ques.)
S14	7c, 9b
F13	2c, 4a
S13	4b
W13	2b
F12	3a
F11	1j, 5
W11	2c
S10	5a
W09	2
S08	5a
W08	5
F07	6, 10
W07	7, 8bc