Engineering and Science Mathematics I

Review for Standard Track Final Exam

Saturday, December 21, 18:30–20:30, Sports Hall I

1. Limits of functions, limits of sequences, one-sided limits: You should be able to solve most problems from the Chapter 2 Review on page p. 96, in particular the following exercises: 15, 21, 31, 39. For the last two problems you may (but don't need to) use Taylor series for the functions in the numerator and denominator (as discussed in class) or l'Hôpital's rule (not discussed in class, but it is essentially the same thing).

   Have a look at some of the Section 11.2 problems as well. Some facts and tricks you should know:

   (a) By setting $x = 1/n$, you can always convert a limit where $n \to \infty$ to a limit where $x \to 0^+$.

   (b) $\lim_{x \to 0} x^k \ln x = 0$ for every $k > 0$.

   Things you should try: p. 632 problems 9, 13, 25, 33. The last one is tricky, but very instructive: First consider the logarithm of this expression so that you can use the Taylor series of $\ln(1 + x)$.

2. Continuity: When is a function continuous, can a discontinuous function be extended to be continuous (p. 97 examples 57–60)? More advanced question: Can you show that differentiability implies continuity?

3. Derivative, implicit differentiation, Taylor series. Typical exam problems will be similar to p. 179 no. 27, p. 208 no. 52, "Compute the derivative of $y = \arctan x$", or "Compute first three non-zero terms of the Taylor series of $f(x) = \ln(1 + x)$ about the point $x = 0$."

4. Curve sketching: Given a function, find

   (a) Domain

   (b) Vertical Asymptotes

   (c) Horizontal Asymptotes

   (d) Extrema

   (e) Points of Inflection

Use all this information to sketch the graph. Expect a final exam question like Problem 1 on Midterm II.

Important: When you find critical points, you *must* check if and how the first derivative changes sign in order to determine whether the critical point corresponds to a a minimum, maximum, or neither. The corresponding check for sign changes of the second derivative to find points of inflection is also necessary.

5. Applied Minimax Problems: There will be (at least) one such problem on the exam. Review the Section 3.6 homework as well as the corresponding questions on Midterm I.

6. Use integration to compute the area under a curve or the area between two curves.

7. Techniques of Integration (Chapter 9): On the exam you will not be told which method to use, so recommended practice material are the Chapter 9 Miscellaneous Problems on page 563.

   As for Midterm II, all integration problems on the exam will be taken literally from pages 563–566.

8. Volume, Arc Length, Surface Area: Expect at least one question on the exam which is similar to homework/quizzes from these topic areas.

9. Initial Value Problems: Know how to solve a separable initial value problem. Again, see homework/quizzes from this topic area.

10. Series, Convergence: Be able to spot a geometric series and compute its limit. Integral test for convergence; spot non-convergence in cases where the sequence of terms that make up the series does not converge to zero.

11. Basic Vector Operations: Dot product, cross product, parametric equations for lines and planes. See homework for Sections 12.2 and 12.3; p. 741 no. 35.

General comments:

- *There is a quiz on the last day of classes.* This quiz is supposed to be a strong hint as to which skills are the most essential for the Final Exam.

- Office hours during reading and final week:

  Friday, 13.12., 14:00, Research I Room 107 (M. Oliver)
  Monday, 16.12., 14:00, Research I Room 114 (S. Mittwollen)
  Wednesday, 18.12., 14:00, Research I Room 114 (S. Mittwollen)
  Friday, 20.12., 14:00, Research I Room 107 (M. Oliver)

- Math Support Center during reading and final week:

  Sunday, 15.12.: *No Math Support Center* Monday, 16.12.–Friday, 20.12.: 19:00–21:00 West Hall 5–8.

- No notes and calculators on the exam.

- Paper will be supplied.