Review for Math 342 - Midterm
The midterm covers the material covered in sections 10.1-16.3 (except section 12.3) of the textbook. Terms in bold are concepts covered in class that are not in the book.

Definitions to know:
1. Scalar product p. 270
2. Norm p. 271
3. Converging sequence p. 278
4. Interior point p. 283
5. Open set p. 283
6. Closed set p. 284
7. Boundary point p. 287
8. Exterior point p. 287
9. Continuous function p. 290
10. Sequential compactness p. 299
11. Compactness (in your notes)
12. Uniform continuity p. 303
13. Metric space p. 314
14. Cauchy sequence p. 322
15. Complete metric space p. 323
16. Limit point p. 348
17. Partial derivative p. 355
18. Directional derivative p. 366
19. Norm of a matrix p. 383
20. Positive definite and negative definite matrices p. 384
21. Linear mapping p. 394
22. Derivative matrix p. 408
23. Stable mapping p. 430
24. Differentiability for functions between Euclidean spaces (from notes in class)

Theorems you should be able to state and/or prove:
1. Cauchy Schwarz inequality p. 274
2. Triangle inequality p. 275
3. Thm. 11.20 and the extreme value theorem p. 301
4. Thm. 11.25 p. 303
5. Thm. 13.20 p. 369
6. Thm. 14.2 p. 374 (1st order approximation theorem)

Theorems and/or facts you should know:
1. Thm. 11.11 p. 294 (equivalent conditions for continuity)
2. Heine-Borel Theorem (relating different definitions of compactness and closed and bounded) and Thm. 11.16 p. 299
3. Prop 13.15 (MVT) p. 365
4. Thm. 13.17 MVT p. 368
5. Thm. 14.13 (Generalizes Cauchy Schwarz) p. 384
6. Thm. 14.22 (2nd order test) p. 391
7. Thm 15.39 (Chain Rule) p. 418
8. Thm 16.9 (Nonlinear stability theorem) p. 431
9. Thm. 16.12 (Inverse Function Theorem) p. 435

You should be able to:
1. Work with dot product and norm for Euclidean space
2. Know and use the triangle and Cauchy-Schwarz inequality
3. Know how to prove sequences in Euclidean space converge or diverge
4. Prove that sets are open, closed, or neither
5. Find the interior, boundary, and exterior of a set
6. Prove that a function is continuous or discontinuous
7. Prove that a set is compact or not and what compactness means for continuity. You should know the definitions of sequential compactness as well as compactness.
8. Know how to prove a space is a metric space and how to prove convergence for sequences
9. Find open, closed, and compact sets for metric spaces
10. Find the gradient of a function, partial derivatives, and directional derivatives and know the connections between these
11. Know how to compute higher order partial derivatives
12. Be able to use the MVT in higher dimensions (usually as a tool to prove other results)
13. Find a tangent plane and first order approximation for a function as well as when these will exist
14. Use the 2\textsuperscript{nd} derivative test to find extreme points
15. **Show that a matrix is positive or negative definite (for instance using Sylvester’s criterion).**
16. Be able to use and apply basic facts from linear algebra as well as the norm of a matrix and the generalized Cauchy-Schwarz inequality.
17. Compute the derivative matrix and give conditions under which we know a derivative exists. **You should also know the definition of the derivative as in your notes since this is not given in the text.**
18. Know the inverse function theorem for 1-variable as well as the general inverse function theorem.
19. Be able to define a stable function as well as know conditions that ensure stability for a function.