NPS Systems Analysis (SA) Certificate Program
Calculus Review

The following calculus and matrix algebra topics provide a mathematical foundation upon which some of your SA courses will rest. Please review these topics using your calculus and linear algebra texts, or one of the suggested texts at the end of this document.

After each topic is a brief description of the key concepts with which you should be familiar.

1. Numbers, inequalities, and absolute values – properties of the real numbers, the real number line, inequalities, and absolute values
2. Trigonometry—radians, polar coordinates, the definition of the trigonometric functions, trigonometric identities, graphs of trigonometric functions
3. Limits, limits at infinity, horizontal asymptotes—the idea of a limit, the limiting behavior of a function at plus and minus infinity, the horizontal asymptote as a description of the limiting behavior of a function
4. Derivatives of polynomials and exponential functions—know how to take derivatives of polynomials and exponential functions
5. The product and quotient rules—use the product and quotient rules to take derivatives of the product and quotient of functions
6. Rates of change in the natural and social sciences—the idea of rate of change: average rate of change, the derivative as an instantaneous rate of change, and some of the ways the derivative is used in the natural and social sciences (velocity, marginal cost, electrical current)
7. The chain rule—for taking the derivative of the composition f(g(x)) of two functions
8. Implicit differentiation—take the derivative of an implicitly defined function
9. Related rates—related rates are an application of the chain rule
10. Maximum and minimum values—local and absolute maximum and minimum values of a function
11. Optimization problems—using calculus to find the local and absolute maximum and minimum values of a function
12. Areas and distances—the connection between the geometric problem of finding the area under a curve, and finding the distance covered by a particle during a certain time interval
13. The definite integral—the definite integral as the limit of a Riemann sum, and the solution to the area and distance problem
14. The Fundamental Theorem of Calculus—the two parts of the Fundamental Theorem which connect derivatives and integrals; the derivative and integral are inverses of each other, in a sense
15. Inverse functions
16. The natural logarithm
17. The natural exponential function
18. Integration by parts—the integral version of the product rule, sometimes useful for finding integrals

19. Approximate integration—not all integrals can be evaluated exactly using calculus, but they can be approximately evaluated numerically
20. Areas between curves—finding the area between two curves
21. Volumes—using the integral to evaluate certain volumes
22. Systems of linear equations—what a system of linear equations is, and how to solve one by the method of Gaussian elimination
23. Matrix algebra—the algebra of adding, subtracting, and multiplying matrices
24. Elementary matrices—the matrices which perform the elimination operations for a linear system, when the system is written in matrix form
25. The determinant of a matrix—an important way of assigning a number to a square matrix, useful in a many areas
26. Properties of determinants—how to find determinants, and their properties

TEXTBOOK RECOMMENDATIONS
(Note: These are recommendations for review to strengthen your preparation for the SA Certificate courses. These are **not** required textbooks for the SA courses themselves.)

Your old College Textbooks – if you are already familiar with them, and marked them up, they should be a good reference for review. If you don't have your old books, consider the following.

Selected Textbooks—these are some possible textbooks to look at, but any good calculus book or linear algebra book will have the topics listed above.

- Calculus (Early Transcendental Function version), James Stewart, 5th edition, Thompson/Brooks Cole, ISBN 0-534-39321-7
- Calculus, James Stewart, 5th edition, Thompson/Brooks Cole, ISBN 0-534-39339-X
- Linear Algebra and Its Applications, David C. Lay, 3rd edition, Addison-Wesley, ISBN 0-201-70970-8

Outline Series – these are some books that provide a summary of the topics that may be adequate for review or as a supplement to a college textbook. These outlines also contain a great number of completely solved problems that are quite good for review.

- Schaum's Outline of Calculus, Frank Ayers Jr. and Elliott Mendelson, 4th Ed., McGraw-Hill, 1999, ISBN 0-070-41973-6

- Schaum's Outline of Linear Algebra, Seymour Lipschutz and Marc Lipson, 3rd Ed., McGraw-Hill, 2000, ISBN 0-071-36200-2

All books are available at www.amazon.com and at www.barnesandnoble.com. Fast and free shipping, and discounts are available.