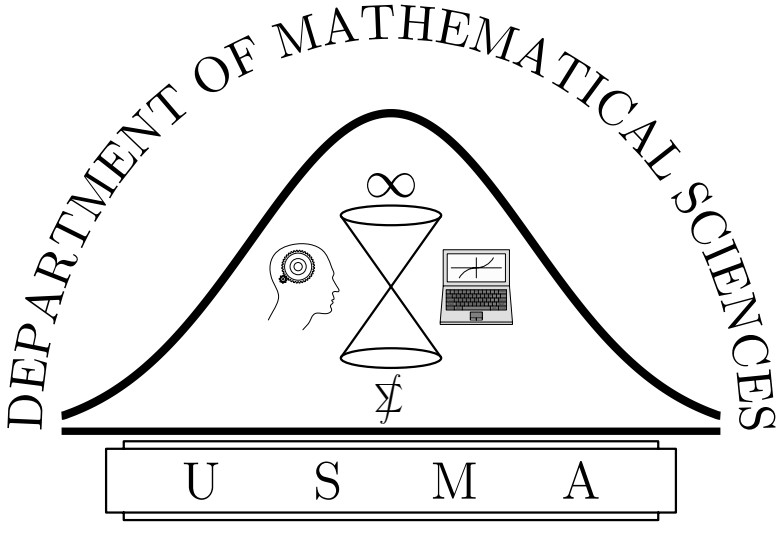
MA205 Student Course Guide & Work Book

Integral Calculus and Introduction to Differential Equations

Department of Mathematical Sciences
United States Military Academy

Spring 2009



DEPARTMENT OF MATHEMATICAL SCIENCES
UNITED STATES MILITARY ACADEMY
WEST POINT, NY 10996-1786

AY 2008-2009
INSTRUCTIONAL MEMORANDUM
NUMBER 205-09-02

MA205–Integral Calculus and Differential Equations (Spring 2009)

1. This memorandum describes the purpose and objectives of MA205, announces its evaluation policy, specifies course material, and discusses cadet professional development.

2. Purpose and Objectives: The purpose of MA205 is to enhance the ability of each cadet to reason scientifically, solve quantitative problems, and communicate results. Specifically, MA205 will encourage cadets to think and act creatively and to communicate in writing and orally using precise language. The overarching objectives in MA205 are: (1) understand the concepts of integral calculus (single and multivariable) and apply these concepts to solve problems, and (2) model problems using ordinary differential equations and apply basic solution techniques. In support of these objectives, the course is divided into three blocks of material:

   (a) Block I: Single Variable Integration and Motion in Space

   (b) Block II: Multivariable Integration and Applications

   (c) Block III: Modeling with Ordinary Differential Equations

   In each of these blocks, we have designed the course to teach you new math skills while reinforcing old ones, promote your conceptual understanding of mathematics, and develop your math modeling and problem solving abilities. The specific objectives for each block and each lesson support these goals.

3. Evaluation: Experience shows that your performance in MA205 will reflect your daily preparation and consistent level of effort. You will need to work hard, both in and out of class, in order to attain the level of understanding necessary to succeed in this course. You will be evaluated on both in class and out of class activities. In class activities may include written exercises, quizzes, presentations, Written Partial Reviews, and a comprehensive final examination. Out of class activities may include homework and projects. The distribution of points for the course is:

   (a) Point Distribution:

Requirement	% Weight	Course Total Points
Instructor Points	13.75%	275
Course-wide Quiz	3.75%	75
WPRs (2)	37.5%	750
Projects (2)	15%	300
TEE	30%	600
Total	100.0%	2000

(b) Final course grades will follow this departments standing guidelines. Scores in the listed ranges are guaranteed, with refinements made for plus and minus grades. However, a score of less than 50% on the TEE (regardless of final course average) may indicate insufficient knowledge or ability and may result in course failure.

Percentage Achieved	Grade
$90 \leq x \leq 100$	A
$80 \leq x < 90$	B
$70 \leq x < 80$	C
$65 \leq x < 70$	D
$0 \leq x < 65$	F

4. Texts and Course Support:

   (a) Calculus Early Transcendentals, Sixth Edition, James Stewart, Brooks/Cole, 2008

   (b) MA205 Homepage: http://www.dean.usma.edu/math/courses/MA205/default.htm.

   (c) Mathematica 6.0.

   (d) MA205 Student Course and Workbook.

   (e) Differential Equations Supplement.

5. Professional Development:

   (a) Expectations for Students in MA205: As you progress through this course you will grow academically and professionally. To help you achieve this growth we have the following expectations for your efforts in MA205:

   - Foundation in the basics of math is cumulative; be prepared to review on your own as necessary. (This will include algebra, trigonometry, MA103, MA104, and any other areas you might need to solve problems in MA205.)
   - Put forth a scholarly effort; officers seek to be excellent in analyzing complex problems and communicating solutions, so start now.
   - Dedicate the time required for success. We have designed this course so that the average student can succeed with a *minimum* of 1 hour of daily preparation.
   - Come prepared for class. Read the assigned reading, work all mechanics based problems, attempt the problem solving problems, and review the Mathematica commands.
   - Work to your potential.
   - Participate in the instruction and discussion. This is your education; take charge!
   - Seek assistance when needed from the text, library, your classmates, or your instructor.
   - Learn something about mathematics; it will help you understand your world.

   (b) Expectations for Instructors in MA205: Your instructor certainly has a role in your growth this semester. Heres what you can expect from him or her:

   - Facilitation of discussion and learning.
   - Assistance in understanding.

- Applications that demonstrate the relevance of your mathematical education.
- Activities that allow you to participate in learning.
- Challenging problems.
- Assistance in time management (expectation of daily preparation, milestones).
- Fairness in grading.
- Timely feedback.
- Enforcement of standards.

6. Scholarship: This course will teach you new concepts in mathematics, but will also build upon what you have already learned. It may therefore be necessary and appropriate to refer to sources of information beyond the course text. Keep in mind the standards of scholarly work: documentation of your work should follow the guidance contained in *Documentation of Written Work*, Office of the Dean, August 2007, and The Little Brown Handbook. If you are not sure about how or when to document a source, consult your instructor **before** submitting your work.

7. I think that you will find this course interesting and applicable, as you will continue to explore the concept and ideas that contain the power and beauty of calculus. For many of you, this will be your final calculus course. However, the problem solving skills and tools that you will learn both in this course and throughout the core math curriculum will be of great value to you in your career as an Army officer. I wish you the best of luck this semester and through the rest of your time here at West Point.

FOR THE HEAD OF THE DEPARTMENT:

TINA HARTLEY
LTC, AD
Program Director

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	5-Jan-09	6-Jan-09	7-Jan-09 ***Lesson Number ->*** ***Lesson Topic ->***	8-Jan-09 1 Introduction to MA205	9-Jan-09 2 Estimation from Functions and Data Sets I	10-Jan-09	11-Jan-09
2	12-Jan-09 3 Estimation from Functions and Data Sets II	13-Jan-09 4 Refining Estimates	14-Jan-09	15-Jan-09 5 PSL 1	16-Jan-09 6 Definite Integrals	17-Jan-09	18-Jan-09
3	19-Jan-09 7 FTC I	20-Jan-09 8 FTC II	21-Jan-09	22-Jan-09 9 Indefinite Integrals and Net Change	23-Jan-09 10 Substitution I	24-Jan-09	25-Jan-09
4	26-Jan-09 11 Substitution II	27-Jan-09 12 PSL 2	28-Jan-09	29-Jan-09 13 Application: Work I	30-Jan-09 14 Application: Work II	31-Jan-09	1-Feb-09
5	2-Feb-09 15 2D Arc Length	3-Feb-09 16 PSL 3	4-Feb-09	5-Feb-09 17 Parametric Equations	6-Feb-09 18 Vector Functions I	7-Feb-09	8-Feb-09
6	9-Feb-09 19 Vector Functions II	10-Feb-09 20 3D Arc Length	11-Feb-09	12-Feb-09 21 Motion in Space I	13-Feb-09 22 Motion in Space II	14-Feb-09	15-Feb-09
7	16-Feb-09 President's Day	17-Feb-09 23 PSL 4	18-Feb-09 24 WPR I	19-Feb-09	20-Feb-09 25 Functions of Several Variables	21-Feb-09	22-Feb-09
8	23-Feb-09 26 Estimations Using Data & Functions I	24-Feb-09 27 Estimations Using Data & Functions II	25-Feb-09 28 PSL 5	26-Feb-09 29 Project Day	27-Feb-09 30 Rectangular Regions I	28-Feb-09	1-Mar-09
9	2-Mar-09 31 Rectangular Regions II	3-Mar-09 32 PSL 6	4-Mar-09	5-Mar-09 33 General Regions I	6-Mar-09 34 General Regions II	7-Mar-09	8-Mar-09
10	9-Mar-09 35 PSL 7	10-Mar-09 36 Polar Regions I	11-Mar-09 37 Polar Regions II	12-Mar-09	13-Mar-09	14-Mar-09	15-Mar-09
11	16-Mar-09 Spring Leave	17-Mar-09	18-Mar-09	19-Mar-09	20-Mar-09	21-Mar-09	22-Mar-09
12	23-Mar-09 38 Center of Mass I	24-Mar-09 39 Center of Mass II	25-Mar-09 40 PSL 8	26-Mar-09 41 WPR II	27-Mar-09	28-Mar-09	29-Mar-09
13	30-Mar-09 42 Modeling with Differential Equations	31-Mar-09 43 Slope Fields I	1-Apr-09	2-Apr-09 44 Slope Fields II	3-Apr-09 45 Euler's Method	4-Apr-09	5-Apr-09
14	6-Apr-09 46 Analytic Solutions: Separation of Variables	7-Apr-09 47 Exponential Growth & Decay	8-Apr-09	9-Apr-09 48 Logistic Models	10-Apr-09 49 PSL 9	11-Apr-09	12-Apr-09
15	13-Apr-09 50 Analytic Solutions: 2nd Order DEs	14-Apr-09 51 Spring Mass I	15-Apr-09	16-Apr-09 52 Spring Mass II	17-Apr-09 53 PSL 10	18-Apr-09	19-Apr-09
16	20-Apr-09 54 Systems of Differential Equations	21-Apr-09 55 Solving Homogeneous Linear Systems I	22-Apr-09	23-Apr-09 56 Solving Homogeneous Linear Systems II	24-Apr-09 57 Solving Homogeneous Linear Systems III	25-Apr-09	26-Apr-09
17	27-Apr-09 58 PSL 11	28-Apr-09 59 WPR III	29-Apr-09	30-Apr-09 60 Oral Project Presentations	1-May-09 61 Oral Project Presentations	2-May-09	3-May-09
18	4-May-09 62 Oral Project Presentations	5-May-09 63 PSL 12	6-May-09 64 Course Review	7-May-09	8-May-09	9-May-09 TEE Week	10-May-09
19	11-May-09 TEE Week	12-May-09 TEE Week	13-May-09 TEE Week	14-May-09 TEE Week	15-May-09 TEE Week	16-May-09	17-May-09

Summary List of MA205 09-01 Course Wide Graded Events

DATE	EVENT	POINTS
29 Jan 09	Course-wide Quiz	75
13 Feb 09	Issue Project 1	
18 Feb 09	WPR I	250
26 Mar 09	WPR II	250
2 Apr 09	Project 1 DUE	150
7 Apr 09	Issue Project 2	
28 Apr 09	WPR III	250
30 Apr 09	Project 2 (Oral Presentation) DUE	150
TBD	Term End Exam	600

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MA205 Syllabus

The Promises. Everyday in our personal experiences, we observe things that change. About the only thing that seems consistent is that everything changes. Our ability to cope with change is often predicated on our ability to measure the changes we see and hopefully, be able to predict future change. Most often our interest in change deals with one of two questions concerning change: how fast the change is occurring and how much change has occurred. Your last course in math, MA104, provided you with the opportunity to explore questions about the ***rate*** or how fast something changed. MA205 will provide you with the opportunity to explore questions about the ***amount of change***.

At one time or another, you have probably observed something and asked a question about its amount of change. An example might be, "If I know a car's depreciation rate, can I determine its future value?" Another example might be "How much water is in that swimming pool?" Some questions, like this one, may not seem like a question about amount of change until we consider the underlying change. In this case, if we consider the changing depth of the water, it becomes one. The one thing all of these questions have in common is that they begin with some information about how fast something is changing and with that information we can determine the amount of change. This course will expose you to many of these kinds of questions and allow you to explore your own. It will build on your understanding of ***rates of change*** from MA104 and introduce you to the concepts of ***accumulation*** and ***integration***. Understanding these concepts will provide you with this new quantitative perspective to your mathematical toolset. Additionally, your understanding of the link between the concepts of ***rate of change*** and ***amount of change*** will allow you to explore a new class of problems. In these problems, we seek to predict how certain phenomena change based on information about their rates of change. "What will be the temperature of a hot cup of coffee in 10 minutes or what will be a country's population in 20 years?" You will be able to explore these and similar ideas with this course's introduction of ***differential equations***.

How will you realize these promises? For you to realize these promises, you should set personal goals to achieve ***understanding of the mathematical concepts*** and ***mastery of the mathematical skills***. To achieve these goals, you need to be an active, participative self-learner. This does not mean you have to learn all of the material on your own, but without some personal responsibility for your own learning, you will not achieve these goals. Daily preparation begins with a conscious effort to meet the objectives of each lesson prior to coming to class. At a minimum, you should come to class having read the assignment, attempted the suggested problems and prepared a list of questions over the objectives you were not able to understand. **Remember: Learning comes from questions, not answers**. Class time will be dedicated to answering these questions, practicing and refining basic mathematical skills and exploring the problems discussed above. Each day should end with a self assessment of your understanding of the daily objectives and actions to correct shortcomings. At the end of the course, you should be able to clearly explain the course concepts of accumulation, integration and differential equations. You should also be able to demonstrate mastery of the basic skills of single and multi-variable integration and differential equations by hand and for more advanced problems, apply appropriate technology (*Mathematica*). Finally, you should be able to apply problem solving skills to real world problems and effectively communicate your process both written and orally, important skills in your future careers. Two course projects will allow you to develop these skills. With a disciplined, consistent effort in daily preparation, you will come away from this course a better learner, a better problem solver and a more critical thinker.

Assessment of your progress and performance. Your progress in this course will be evaluated by course

wide examinations (Course Quiz, WPRs, Projects, TEE) and instructor evaluations (quizzes and/or graded homework). The final grade you receive is based on the grading guidelines found on page three of this guide. Each of the grades listed in the right column will be a reflection of your ***demonstrated*** level of understanding and performance as described in the left column.