The VMI Core Curriculum:
The Nucleus of Citizenship and Leadership

MA 123-124 – Calculus with Analytic Geometry I and II

A. Course Information

1. Department: *Mathematics and Computer Science*

2. Core Sequence Numbers: *MA 123/124* 3. Credit Hours: *6*

4. Full Course Title: *Calculus with Analytic Geometry I and II*

5. Course Description:

   MA 123: Calculus and Analytic Geometry I
   Plane analytic geometry with single variable differential calculus. Limits, derivatives, applications of derivatives, derivatives of transcendental functions and basic integration formulas. Prerequisites: Pass the Calculus Placement test with grade of 70% or higher, or achieve a grade of C, or higher, in MA 114.

   MA 124: Calculus and Analytic Geometry II
   A continuation of MA 123. Integration and its applications, methods of integration, L'Hôpital's Rule, improper integrals, infinite sequences and series, power series. Prerequisites: A grade of C, or higher, in MA 123.

6. Prerequisite(s): *Successful completion of the Calculus Placement Test or MA 114 or permission of the Head of the Department of Mathematics & Computer Science.*

7. Indicate whether this is
   ____ A new course
   __x_ An existing course with less than 75% content revision
   ____ An existing course with greater than 75% content revision

8. When do you expect to offer the course first? *Fall 07*
   And on what schedule thereafter? *Every semester, summer session, and in the VMI Summer Transition Program.*

9. Expected enrollment per section: *25 (maximum)*

10. Provide the following information for each faculty member who will teach the course. (Department heads may update this list as needed.)

Dr. Robert Bennell
Col. Lee Dewald
Col. Tom Lominac
Col. Soe Than
Col. Mike Tierney
Col. Vonda Walsh
CDR Dan Joseph
LTC Troy Siemers
Maj. Greg Hartman
Dr. Lea Lanz

Mr. Richard Miller – Part time

11. Resources (existing or new) required to offer the course for the Core Curriculum:

A. *In order to use technology efficiently, smart classrooms will be required for all sections of MA 123 and MA 124.*
B. *Financial support will be necessary in order to send members of the department to workshops on active learning and assessment at the Joint Mathematics Meetings or other similar venues.*
C. *In order to facilitate the administration of the common portion of the final exam (and perhaps an entirely common final exam in the future) the department requests a common final exam block for MA 123 and MA 124 courses.*

B. Core Curriculum Contributions

1. Primary Core Curriculum Component for which the approval for the course is proposed: *Mathematical Reasoning*

2. Indicate any meta-competencies that the proposed course will address and assess. *NA*

D. Syllabus

The attached syllabi will be used in each section of MA 123 and MA 124 taught during the regular school year and summer sessions. Each instructor may also attach any information he or she thinks necessary to facilitate a smooth running class. However, the basic contents of these syllabi—including weights for assignments, the technology statement, etc.—may not be changed with out written consent of the Core Curriculum Oversight Committee. While, suggested problems may be changed to suit individual

instructors' preferences, the daily schedule must be followed, in general, and tests must be given within a day or two of the given schedule.

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D. Discussion

1. Briefly describe how the department views the contribution of the course to the overall goal of the Core Curriculum.

   The VMI Core Curriculum is designed to cultivate the essential characteristics of the citizen soldier – a person of character who is able to anticipate, respond, and lead in a complex and changing world.

   The core sequence in calculus contributes to the overall goals of the Core Curriculum by providing opportunities to improve decision-making skills; to write and speak effectively; to analyze and interpret data; to solve quantitative problems; to logically process information leading to effective solutions of problems; to use technology to solve problems; to stimulate intellectual curiosity; and to encourage life-long learning.

2. Briefly describe how the course will address each of the intended learning outcomes required by the core curriculum component for which approval is sought. (See Table 2)

   The department has mapped course objectives to the QEP MAI Learning Outcomes in Appendix F1 of VMI's Assessment Plan in the Institute's 2007 Response Report to SACS. In Appendix F2 of that same document we have indicated how and where each QEP MAI Learning Outcome is assessed.

3. Briefly describe how the course will address any of the meta-competencies identified in B.2.

   Mathematics in general, and calculus in particular, requires critical thinking to achieve mastery. To enhance the critical and creative thinking aspect of the sequence, applied problems will be assigned throughout each semester. These problems require the student to take the information that they have learned and apply it to a situation that they have not encountered. This type of exercise requires a good measure of creativity.

   The calculus sequence is an ideal setting in which to teach students the necessity of proper written mathematical communication. As in any discipline, correct solutions that are not communicated effectively are useless.

The use of technology is more and more prevalent in solving real world problems. Mathematical technology (e.g. the graphing calculator and mathematical software such as MATLAB) is introduced in the calculus sequence and, though its use in the calculus sequence is minimal, it is expected to be used throughout the remaining required and elective mathematics courses for math, science, and engineering majors.

A desire to be a life-long learner in mathematics is cultivated in the calculus sequence by instructors who actively engage their students with interesting and historically significant problems. Students come to understand that one's ability in mathematics grows with practice and in application to relevant problems of today's world.

4. Describe the plan for assessing the outcomes identified in D.2 and, when appropriate, D.3. (This plan should be developed in close consultation with the Core Curriculum Assessment Working Group and/or the Office of Assessment and Institutional Research.)

   Summative Assessment: The department has developed a common portion of the MA 124 final exam that will be given each time MA 124 is taught. Each question on the common portion of the exam has been linked to an MAI Learning Outcome. This common portion will be graded by a committee according to a prescribed rubric. Upon completion of the course and grading of the final exams, the Course Coordinator will solicit input from all of the instructors who taught the course and make a report to the Department Head with an emphasis placed on how to improve the course. The results, along with required and suggested actions, will be shared with the department at the next departmental meeting and at the first meeting of the course instructors for the new term.

   Formative Assessment: Prior to each semester the Course Coordinator will ensure that all instructors are on the approved instructor list. He will also check with the Department Head to ensure that SACS qualifications are on file in the Dean's Office for all instructors. The Course Coordinator will hold meetings with all instructors at least four times during the semester. The purpose of each meeting is outlined below.

   Meeting 1: Pre-Semester Meeting

   A. *The Course Coordinator will review all syllabi to ensure that they are satisfactory.*
   B. *He will preview the course and discuss any required or suggested actions resulting from previous summative assessments.*
   C. *Strategies for the first portion of the semester will be discussed in some detail including discussion on the bank of application scenarios that must be covered. (See D.5)*

D. Common questions for tests one and two will be disseminated (one or more common questions for each test). These questions will be linked to MAI learning outcomes.

Meeting 2: Mid-Semester Meeting

A. Performance on tests (to include performance on the common questions) and performance of the class in general will be discussed. The group will qualitatively analyze the performance and make recommendations for improving learning in the next semester and in the second half of the current semester.

B. Success of the application scenarios will be discussed.

C. Strategies for the second half of the semester will be discussed in some detail, including discussion on the bank of application scenarios that must be covered.

D. Common questions for tests three and four will be disseminated (one or more common questions for each test). These questions will be linked to MAI learning outcomes.

Meeting 3: Pre-Exam Meeting

A. Performance on tests (to include performance on the common questions) and performance of the class in general will be discussed. The group will qualitatively analyze the performance and make recommendations for improving learning in the next semester.

B. Success of the application scenarios will be discussed.

C. The final exam will be discussed, in particular the administration and grading of the common portion of the final exam for MA 124.

D. Final comments and suggestions from the instructors will be solicited.

Meeting 4: Post-Exam Meeting

A. Overall performance in the course, including the exam, will be discussed and analyzed qualitatively. Recommendations will be made for improving the course in following semesters.

B. The Course Coordinator will solicit input for the end of the semester report to the Department Head.

The focus of all of these activities will be the consistent improvement of the MA 123-124 Core Sequence.

A detailed assessment plan for these courses is available on the VMI webpage for Core Curriculum Assessment: http://new.vmi.edu/show.asp?durki=8292.

5. Core curriculum courses must be taught with an explicit effort to stimulate students' intellectual curiosity and awareness of why these requirements have been established as the core academic contribution to the Institute's mission to develop citizen-soldiers. The Core Curriculum Oversight Committee therefore

encourages instruction that promotes active, engaged learning. Describe how the pedagogy for this course addresses the issue of relevance and routinely engages students as active learners.

As with any course, students will learn Calculus better if they can understand why it works and how it is relevant. With this in mind, instructors will try to stimulate students to do more than just memorize algorithms for solving problems. Through a focus on understanding, appropriate technology and valuable assignments each instructor will encourage students to actively engage in the material covered and the learning objectives behind this core sequence.

Calculus is a "contact sport" which is learned by doing and practicing. In-class assignments and homework sets will be given which challenge students to learn basic calculations but also challenge students with "real-world" application problems. Calculus is also a "team sport" where one learns with and from fellow participants. Therefore students will be engaged in problem solving in teams during classes and extensive homework assignments.

In addition, each instructor will spend a substantial amount of one class period each testing period "discussing" an application scenario from an approved bank of scenarios. This application scenario will allow students to work through the mathematical modeling process: 1) Take a real world problem. 2) Create a mathematical model. 3) Solve the mathematical model. 4) Interpret the mathematical solution in the real world scenario. 5) Revise the model and repeat steps 3 – 5. (In this context "discussing" means assigning the scenario to groups of cadets and leading them through the modeling process in class. The goal is that by the last scenario of the semester the instructor will merely assign the scenario and allow the students to complete the process on their own. At a minimum, the final application scenario each semester must be graded.) This modeling process promotes learning by experience and helps connect the learning process to reality. This connection should help trigger the students' interests and their commitment to learning.

Here is an example of a possible application scenario:

> *A security camera is centered 50 ft above a 100 ft hallway. If the camera has a constant angular rate of rotation the objects directly below the camera will have less time in the direct line of sight of the camera than the objects at the ends of the hallway. You want to design a system with a variable rate of rotation constant rate of movement of the "scanning beam" along the floor of the hallway. Find a model for the variable rate of rotation if* $\left|\frac{dx}{dt}\right| = 2$ *feet per second.*

A figure showing the camera location and the hallway would be attached. The students would be required to find a mathematical equation that relates the angular rate of rotation of the camera and the location of the "scanning beam" on the floor of the hallway. In order to solve for the requested information the

students would have to find an implicit derivative and determine the mathematical and contextual domains of the variables. From there, the instructor could ask students to graph the angular rotation, discuss limitations of the model, discuss how the model would differ mathematically and physically if the length of the hallway was increased, etc… .

(Note: With multiple scenarios to choose from in each testing period, each instructor has a greater chance of finding a scenario that he is excited about. The more enthusiastic an instructor is about the application scenario the more enthusiastic the students will be and the more successful the process will be.)

6. If this is a multi-section course, what faculty development plans does the department have for ensuring consistency and effectiveness across the various sections? Please note any resource requirements for faculty development in A.11

   This is a multi-section course in each academic term and a single section course in the summer sessions. The Course Coordinator is responsible to the Department Head to ensure that the common course syllabus is being generally followed and that the common portion of the final examination is graded consistently. Essentially every full-time member of the math faculty and any part-time mathematics professor are qualified to teach this core sequence in calculus. Prior to each semester and periodically throughout the semester, the Course Coordinator will meet with those instructors assigned to teach in this core sequence and will discuss the goals of this core course.

   In addition, the Department Head will encourage faculty members to attend workshops at the Joint Mathematics Meetings (or elsewhere) that will train instructors on methods of promoting active learning and assessment. The Department Head will also encourage faculty members to start participating in the grading of the AP Calculus Exam.

Submitted by:

CDR Daniel Joseph
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MA 123-124 Course Coordinator
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