Critical Thinking Designator Form

Title Abbreviation: Calculus / Analytic Geom I (CT)

Alpha Designator/Number: MTH 229

Contact Person: Carl Mummert 696-6156

Please briefly explain (noting where materials are located in the syllabus) how your course meets the following criteria. Please consult the "Criteria for CT Courses" document.

COURSE CONTENT
Core Domain Focus:

The primary Core Domain for MTH 229 is mathematical and abstract thinking. Objectives 1, 2, and 4 on the general syllabus relate to the mathematical techniques of calculus that are taught in the course. Objective 3 requires students to construct and evaluate mathematical arguments. Objective 8 requires students to develop their estimation sense to evaluate whether answers are reasonable in a real-world setting.

Other Core Domains Addressed:

Information and technical literacy Objectives 6 and 7 require students to interpret a description of a problem and interpret this information to select an appropriate mathematical model that is appropriate for the problem and which can be used to obtain the desired solution.

Oral, written, and visual communication. Objective 3 requires students to express mathematical arguments verbally. Objective 5 requires students to explain mathematical concepts verbally. Objectives 2 and 4 include the study of graphical data, a form of visual communication.

LEARNING OUTCOMES (Must meet at least three of the five)

Reasoning
Objective 3 requires students to construct verbal arguments to verify properties of the mathematical objects they study. Objective 8 requires students to analyze results and explain why they are valid or invalid.

Cultural Judgment

Representation
Throughout the course, students work with information presented symbolically, graphically, in tabular form, and verbally. They must interpret information in these forms, analyze it according to the purpose of the problem, and then produce a solution in the desired form.

Reflection

Information Literacy
Throughout the course, students are required to take the information given to them in problems, determine which part of it is relevant to the purpose of the problem, and to use the information effectively to accomplish that purpose. Objective 2 requires students to understand and access the types of information that can be obtained from graphical or tabular data. Objective 7 requires students to determine the information needed to solve a particular problem and to obtain that information from the problem statement and from previous knowledge, as appropriate. Objective 8 requires students to determine what criteria should be used to analyze a solution and to then apply those criteria.
PEDAGOGICAL METHODS

Variety of methodologies:

Possible pedagogical methods include lecture, small group activities, out-of-class assignments, and computer labs.

CLASSROOM ASSESSMENTS

Measurements of higher-order critical thinking skills:

Several objectives focus on higher-order reasoning skills, so that assessments of those outcomes will measure the development of these skills. In particular, objectives 3 and 5 develop students’ higher-order thinking skills, as constructing a mathematical argument or explaining a situation verbally requires students to go beyond the mere techniques that have been used, and to focus on meaning rather than process. Objective 8 develops students’ ability to synthesize and compare information from the mathematical perspective and the perspective of an applied area.

Variety of assessments:

Instructors are required to select a variety of assessments, both formative and summative, to support student learning. By approving the general syllabus for the course, the department commits that all instructors will design their assessments to cover all the course objectives.
Request for Undergraduate Course Change

1. Prepare one paper copy and obtain signatures from the Department Chair/Head, Librarian, and College Dean. 2. Submit the form to your College Curriculum Committee. 3. After attaining the signature of the College Curriculum Chair, send the paper copy to Brian Morgan in Integrated Science & Technology. 4. Send an identical (sans signatures) ELECTRONIC COPY and all supporting documentation in PDF format by email to morgan16@marshall.edu

College: ___________ Department/Division: ___________ Current Alpha Designator/Number: ___________

Carl Mummert Phone: 696-6156

CURRENT COURSE DATA:

Full Course Title: Calculus with Analytic Geometry I

Catalog Title Abbreviation: Calculus / Analytic Geometry

MTH 229 Credit Hours: 5

Alpha Designator/Number: ___________

Term for which changes will be effective [Fill in with appropriate calendar year.]:

fall _______ Spring _______ Summer _______ Other _______

CHECKLIST/QUESTIONS:

1. Complete this three page form in its entirety and route through the departments/committees below for changes to a course involving: course title, alpha designator (see accompanying note to the section on the next page), course number, course content, credit hours, or catalog description.

2. If this change will affect other departments that require this course, please send a memo to the affected department and include it with this packet, as well as, the response received from the affected department.

3. If the changes made to this course will make the course similar in title or content to another department’s courses, please send a memo to the affected department and include it with this packet, as well as, the response received from the affected department.

4. List courses, if any, that will be deleted because of this change (must submit course deletion form):

5. If the faculty requirements and/or equipment need to be changed upon approval of this proposal, attach a written estimate of additional needs.

6. If library resources are deemed inadequate, include in the rationale a plan to overcome this. The plan must include the cost as stated by the Dean of Libraries.

7. Send a copy of this completed form to the Marshall University Catalog Editor.

SIGNATURES: [If disapproved at any level, do not sign. Return to previous signer.]

Date: 2/10/11

Date: 2/11/11

Date: 2/15/11

Date: 2/22/11

Department Chair/Division Head: ________________________________

Registrar: ________________________________

Librarian: ________________________________

College Dean: ________________________________

College Curriculum Chair: ________________________________

General Education Council Chair *: ________________________________

University Curriculum Committee Chair: ________________________________

Faculty Senate Chair: ________________________________

VP Academic Affairs/VP Health Science: ________________________________

* - Signature necessary only if course is to be Core Curriculum Course

University Curriculum Committee – Course Change Form

Revised 11/02/2009
Change in CATALOG TITLE:  ☑ Yes  ❑ No

From:  Calculus I / Analytic Geom
To:  Calculus I / Analytic Geom (CT)  

(Limited to 30 characters and spaces.)

New Full Catalog Title:  Calculus with Analytic Geometry I (CT)

Change in ALPHA DESIGNATOR:  ❑ Yes  ☑ No

From:
To:

Change in COURSE NUMBER:  ❑ Yes  ☑ No

From:
To:

Change in CONTENT:  ❑ Yes  ☑ No

From:
To:

Change in CREDIT HOURS:  ❑ Yes  ☑ No

(A change in credit hours requires documentation that specifies the work requirements have been adjusted accordingly.)

From:
To:

Change in CATALOG DESCRIPTION:  ☑ Yes  ❑ No

(Limit of 30 words. If change is substantial, document in the rationale. If change is minor, simply show the change below.)

From:
An introduction to analytic geometry. Limits, derivatives, and integrals of the elementary functions of one variable, including the transcendental functions.

To:
An introduction to calculus and analytic geometry, emphasizing critical thinking. Limits, derivatives, and integrals of the elementary functions of one variable, including transcendental functions.
Rationale for changes:
The changes to the catalog title and catalog description are required as part of the application to make Math 229 a Core Curriculum I (CT) course.
Math 229: Calculus with Analytic Geometry I (CT)
General syllabus

Course Description  An introduction to calculus and analytic geometry, emphasizing critical thinking. Limits, derivatives, and integrals of the elementary functions of one variable, including the transcendental functions. 5 hours.

Prerequisites  Math ACT of 27 or above, or MTH 132.

Course goals

1. To give students an understanding of the fundamental concepts of calculus and an appreciation of its many applications.

2. To develop critical thinking skills by asking students to convert real-world problems into forms suitable for calculus, and interpret the results of calculus in real-world terms.

3. To provide students with a deeper understanding of the mathematics that is used in their science and engineering courses.

4. To develop facility in using graphing calculators and computers to solve mathematics problems.

5. To satisfy program requirements.

Objectives

1. Students should be able to evaluate limits, derivatives, and integrals symbolically.

2. Students should be able to approximate limits, derivatives, and definite integrals from tabular and graphical data.

3. Students should be familiar with the definitions of limits, derivatives, and integrals; be able to apply these definitions to test properties of these concepts; and be able to produce verbal arguments and examples showing that basic properties hold or do not hold.

4. Students should be able to apply the techniques of calculus to answer questions about the analytic geometry of functions, including vertical and horizontal asymptotes, tangent lines, local extrema, and global extrema.

5. Students should be able to verbally explain the meaning of limits, derivatives, and integrals in their own words, both in general terms and in the context of specific problems.

6. Students should be able to select or construct an appropriate function to model an applied situation for which calculus is applicable, based on a verbal description of the situation.

7. Students should be able to apply techniques of calculus to solve applied problems from fields such as engineering and the sciences.

8. Students should be able to interpret symbolic and numerical results in real-world terms, and analyze the validity of their results in a real-world setting.

Assessments  Instructors will choose assessments to support and measure student mastery of the course objectives. These assignments will be chosen to support the course goals and objectives as well as the individual instructors’ teaching styles. Assessments will include:
- **Summative assessments** Exams, portfolios, or other assessments that directly measure student mastery of the course objectives. These will include questions that require students to apply their skills to solve problems from other fields such as engineering and the sciences. These will also include questions that require students to produce verbal arguments about general concepts and specific problems.

- **Diagnostic and/or formative assessments** Homework, homework quizzes, in-class quizzes, and other assessments that support student learning before summative assessment and allow students to adjust their studying to reflect their progress. These assignments may be graded or ungraded.

Each instructor will design a personal syllabus that includes both kinds of assessments, subject to the following requirements:

- **Multiple representations** Students are presented with information in symbolic, tabular, graphical, and verbal form, and they are required to produce answers in each of these forms.

- **Information literacy** Students are required to interpret real-world problems, which might be underspecified or overspecified; to convert the information in these problems to a form suitable for mathematical analysis; to interpret their results in real-world terms; and to evaluate the plausibility or validity of their mathematical results in the context of an applied situation.

- **Objectives** All eight of the course objectives are covered by both summative and formative or diagnostic assessments.

Many kinds of assessments are acceptable, including examinations, portfolios, computer labs, quizzes, homework, homework quizzes, and other assessments.

**Technology** Students are required to have graphing calculators and MU computer accounts during this course. Computer labs may be assigned at the discretion of the instructor.

**Topics covered**

1. **Brief review of basic concepts of algebra** Number systems. Distance formula. Slope of a line. Standard equations of lines.

2. **A library of functions** The basic equations and qualitative behavior of linear functions, power functions, polynomial functions, rational functions, exponential and logarithmic functions, and trigonometric functions.


This is an example of a possible course design using the proposed general syllabus for Math 229. Each instructor will design a particular individualized course syllabus in accordance with the requirements of the general syllabus.

Course  Calculus with Analytic Geometry I (CT)

Description  An introduction to calculus and analytic geometry, emphasizing critical thinking. Limits, derivatives, and integrals of the elementary functions of one variable, including the transcendental functions. 5 hours.

Domains  Mathematical and abstract thinking; information literacy; oral, written, and visual communication

Classroom  TBA

Meetings  TBA

Prerequisite  MTH ACT of 27 or above, or MTH 132.


Instructor  TBA

Contact information  TBA

Office hours  TBA

Course goals  1. To give students an understanding of the fundamental concepts of calculus and an appreciation of its many applications.

2. To develop critical thinking skills by asking students to convert real-world problems into forms suitable for calculus, and interpret the results of calculus in real-world terms.

3. To provide students with a deeper understanding of the mathematics that is used in their science and engineering courses.

4. To develop facility in using graphing calculators and computers to solve mathematics problems.

5. To satisfy program requirements.

Objectives  1. Students should be able to evaluate limits, derivatives, and integrals symbolically.

2. Students should be able to approximate limits, derivatives, and definite integrals from tabular and graphical data.

3. Students should be familiar with the definitions of limits, derivatives, and integrals; be able to apply these definitions to test properties of these concepts; and be able to produce verbal arguments and examples showing that basic properties hold or do not hold.

4. Students should be able to apply the techniques of calculus to answer questions about the analytic geometry of functions, including vertical and horizontal asymptotes, tangent
lines, local extrema, and global extrema.

5. Students should be able to verbally explain the meaning of limits, derivatives, and integrals in their own words, both in general terms and in the context of specific problems.

6. Students should be able to select or construct an appropriate function to model an applied situation for which calculus is applicable, based on a verbal description of the situation.

7. Students should be able to apply techniques of calculus to solve applied problems from fields such as engineering and the sciences.

8. Students should be able to interpret symbolic and numerical results in real-world terms, and analyze the validity of their results in a real-world setting.

**Learning outcomes**  
1. **Reasoning**  
   Calculus is not simply a technique for computing numerical answers: it is also a collection of reasoning techniques that allow us to understand how changing quantities behave. This understanding is fundamental to progress in science and engineering. Students will use mathematical reasoning in their study of calculus concepts, to verify properties of the concepts they study, and they will use scientific reasoning, to determine whether possible solutions are reasonable for a given situation;

2. **Representations**  
   Students will work with information specified in verbal, graphical, tabular, and symbolic forms. Many problems will require students to take information in one of these forms, analyze it, and create a solution in a different form. Students will be required to produce verbal explanations of the meanings of mathematical concepts, both in general and in the context of specific problems.

3. **Information literacy**  
   To solve the applied problems in this course, students must determine which information in the problem is relevant to the solution; access this information and use it to obtain a mathematical solution; and then translate the mathematical solution back into the language of the original problem.

**Grading**  
Homework and quizzes (25%) – These are formative assignments to enable students to learn the material and assess their own mastery. Weekly written homework will engage the students with the material of the course and give them an opportunity to practice their skills in the domains of the course. These assignments will include numerical and symbolic problems, and problems that must be answered verbally. There will be quizzes on most weeks that do not have examinations.

Exams (15% each) – there will be three in-class exams during the semester. These are summative instruments to assess student learning.

Final exam (20%) – a comprehensive examination that will require students to demonstrate their mastery of the course material and their ability to solve problems that integrate several.

Final letter grades will be assigned on the following scale: A – 90%; B – 80%; C – 70%; D – 60%. The course is not graded on a curve.

**Academic honesty**  
Students are required to follow the academic honesty policies of the university and the College of Science.

**Technology requirement**  
Students are required to have a graphing calculator for homework, quizzes, and exams.