Class Syllabus / Policy for Fall 2018
MTH 333 Section 001: Multivariable Calculus

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Office: Math 308

Office Hours: Mondays, Tuesdays, and Wednesdays from 9:30-10:30, or by appointment (This means you need to come see me when you have a question).

Class meeting time and place: Mondays, Wednesdays, and Fridays from 11:00 - 11:50 AM in Math 208 with Lab on Tuesdays from 2:00-3:15 in Math 208


EXPECTATIONS AND ASSESSMENT

To succeed in this class, you are expected to develop two kinds of skills simultaneously: computational facility and conceptual understanding. Both are essential to mastery. You will also work to improve your communication skills—with each other, with me, and with the rest of the world.

Daily work

Multivariable calculus has a plethora of interrelated skills. Not all of them are complicated— in fact, many are quite simple computationally—but they form a network of ideas that has profound implications and enables powerful analysis. The best way to master this network is through daily practice.

Reading: Most days, you will be expected to read a section of the textbook before coming to class. This will be your primary first exposure to new material. Little time in class will be spent on lecture.

Discussion and presentation: Instead of lecture, collaboration and problem-solving will occupy most of our meeting time. You will be given one or more questions to address, and we will discuss different approaches to answering these questions developed within the class.

VR Assignments: Between some classes, I will have you view lessons and demonstrations on the Calculus in Virtual Reality App. This will be your primary first exposure to the geometry and graphs of multivariable calculus. One of the most difficult skills in this course to build is the visualization of graphs and associated measurements in three (or more!) dimensions. These lessons and demonstrations have been created to help you see these objects in their native dimension.

Geometry/Concept Quizzes: We will have weekly (each Monday) geometry/conceptual quizzes which are either graded Satisfactory or Unsatisfactory. If you get an unsatisfactory, then you can do the follow-up assignment to a satisfactory level by the Friday of that week. Successful completion of the follow-up assignment will change your unsatisfactory to satisfactory for that week.

Programming/Visualization in Sage or CalcPlot3D: Computer literacy is a crucial skill in today’s world. The computational and graphing capabilities of modern computers also make it easier to explore complex mathematical ideas without always getting bogged down in calculation. We will take advantage of some of the resources available via the SFA Sage Mathematics server
(https://sagemath.sfasu.edu/), which includes a suite of software for computation. If you are not able to log in to the local sage server, let me know immediately. We will also be using the visualization software CalcPlot3D (https://www.monroecc.edu/faculty/paulseeburger/calcnsf/CalcPlot3D/).

**Lab Projects:** We will have 4 projects this semester that will be scored as either: NW - Needs Work, P – progressing, G – Good, E – Excellent. This is the order from lowest to highest standard. You will have the possibility to revise your project write-up once to improve your score based on my comments. Some projects will be individual, and some will be small group based.

**Content Quizzes:** We will have weekly (each Friday) quizzes which will be your first attempt at each Content Standard.

**Exams:** There will be four in-class exams during the semester. On these exams, you will not receive a grade but rather you will have your second possible assessment on the standards covered since the previous exam.

**Reassessments:** After a standard has been assessed on an exam, if you wish to have a reassessment in order to improve your score, contact me to arrange a time. You will need to let me know ahead of time which standard you wish to have reassessed. I will reassess up to two standards per student per week.

WebWork HW: You will have online homework available for you to practice but the WebWork scores will not be a formal part of your grade. You can log into the course at https://webwork.sfasu.edu/webwork2/MTH333-Fall18/

**Standards Based Grading**

Grading will be based on a collection of *standards*, not on points or percentages. Each standard reflects a skill or related set of skills you are expected to master for this class. My hope is that this method of grading, called *standards-based grading* (SBG), will keep you clearly informed as to the expectations of the class and how well you are meeting them, while also removing the (often distracting) elements of linear grading that uses letters or total points. Learning is not always a straightforward process, and part of the purpose of SBG is to give you as many opportunities as possible to demonstrate your understanding. I will be glad to do everything I can to help you towards your goal of mastery. If you have questions or concerns at any time, please feel free to discuss them with me.

**Content standards:** A full list of the standards appears later in this syllabus. They are listed approximately in the chronological order we will cover them. Each standard represents ~1–2 days of classwork.
- To **COMPLETE** a Standard, one must earn a Satisfactory (S) grade on that Content Standard during a quiz, exam, or reassessment.
- To **MASTER** a Standard, a second grade of Satisfactory (S) must be earned on that same Content Standard during a quiz, exam, or reassessment.
On quizzes, exams, or reassessments, Standards will also be graded either Satisfactory (S), Progressing (P), or Incomplete (I) based on the following general criteria.

<table>
<thead>
<tr>
<th>Mark</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>The submission gives complete, clearly-written, and well-reasoned responses. The solution is organized in a thoughtful manner and the mathematics is correct, with few minor errors which do not call into question your understanding of concepts.</td>
</tr>
<tr>
<td>P</td>
<td>The submission is complete, neatly written up, and partial understanding of concepts is evident, but there are issues in the writing, mathematics, or reasoning that require revision.</td>
</tr>
<tr>
<td>I</td>
<td>The submission has significant omissions or widespread issues so that not enough information is present to determine whether there is adequate understanding.</td>
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You will always have opportunities to show improvement, until the end of the course. Do not put off learning the material, however; later skills depend on earlier ones, and it will be hard to catch up if you fall too far behind.

**General Standards:** General Standards are evaluated a bit differently than the content standards. Each General Standard is described below.

G.1 Participation – Your active participation in class is crucial both to your own learning and to the success of all. Attendance is therefore required, as is a willingness to share ideas and to make brief presentations.

Mastery – Continued, thoughtful participation in asking and answering questions as well as presenting work for guided-inquiry problem sets.

Complete – No issues with attendance, and participation is adequate.

Incomplete – Issues with attendance, participation, or maintaining respectful classroom environment.

G.2 Algebra/Early Calculus – In addition to the new material covered in this class, you will often need to apply skills acquired in earlier math classes. We will review these topics to an extent, but it is principally your job to master these skills. The “Algebra/Early Calculus” standard will be evaluated on an ongoing basis, as an assessment of your ability to accurately simplify, expand, and otherwise manipulate symbolic expressions, including finding derivatives and antiderivatives.

When I see evidence that your algebra/early calculus skills are inhibiting your understanding and ability to communicate multivariable calculus topics, I will notify you and make suggestions on how to improve your standing in this General Standard. It will be up to you to make sure you demonstrate these skills in future assessments.

G.3 Homework – The goal of homework is for you to practice and take risks as you’re learning new material. Thus, it is important is that, as much as possible, you do the work on your own and take the opportunity to make mistakes. You are free to work with others on homework, but I strongly encourage you to attempt the exercises on your own first. You learn the most from making mistakes and thoughtfully correcting them.
Some homework will be exercises from the textbook to hone your computational abilities. These do not need to be turned in unless explicitly stated. More substantial exercises, which will involve modeling and creative use of the ideas of the class, will be assigned about once a week and should be neatly presented. If you have a question about whether a problem needs to be written up, then please ask me and I would be happy to clarify.

Homework is a record of your practice, based on completion. You will earn a **Mastery** grade for submitting at least 90% of the required assignments, **Complete** for 70–90%, and **Incomplete** otherwise.

**Final letter grades.** At the end of the semester, I am required to submit to the university a letter grade reflecting your achievement in this class. Here is how that grade will be determined.

<table>
<thead>
<tr>
<th>Semester Grade</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
</tr>
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<tbody>
<tr>
<td>Standards Assessments: See below for how each Standard is assessed.</td>
<td>Complete on at least 20 Standards</td>
<td>Complete on at least 20 Standards AND Mastery on at least 7 Standards</td>
<td>Complete on at least 22 Standards AND Mastery on at least 12 Standards</td>
<td>Complete on at least 25 Standards AND Mastery on at least 17 Standards</td>
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<tr>
<td>Geometry/Concept Quizzes:</td>
<td>60% Satisfactory</td>
<td>70% Satisfactory</td>
<td>80% Satisfactory</td>
<td>90% Satisfactory</td>
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<tr>
<td>Labs/Projects:</td>
<td>All labs at least Progressing</td>
<td>Three labs at least Good and the remaining lab needs to be at least Progressing</td>
<td>All 4 labs at least Good</td>
<td>At least 3 labs Excellent</td>
</tr>
</tbody>
</table>

At this point it should be clear how you can improve your grade at any time during the semester: *improve your scores on the standards!* Higher levels on a standard do not just indicate more work that is done, but a fuller understanding of the ideas of the course and how to apply them.
List of Content standards

The content standards are listed (roughly) chronologically. Each standard corresponds to one or two days of class. The verb clauses under a standard each complete the sentence, “Student will be able to ...”

C.1 Vector operations – compute and interpret sum, scalar multiples, dot product, determinant, and cross product of vectors in $\mathbb{R}^2$ and $\mathbb{R}^3$

C.2 Parameterization of curves – convert between parameterizations in 2- and 3-D and geometric descriptions of curves

C.3 Flat Graphs – graph, convert between representations, and interpret the properties of flat graphs (lines and planes) in 2 and 3 dimensions

C.4 Equations and transformations of surfaces – describe planes, spheres, quadric and other common surfaces using equations, vectors, or functions

C.5 Coordinate systems – describe points and regions using rectangular, cylindrical, or spherical coordinates; convert between coordinate systems

C.6 Vector-valued functions – apply concepts of single-variable calculus (limits, derivatives, integrals) to parametric curves in $\mathbb{R}^2$ or $\mathbb{R}^3$; find parametrizations of lines, circles, and other curves

C.7 Properties of curves – describe motion via vector-valued functions; find arc length, curvature, and acceleration of a curve

C.8 The TNB-frame of a curve – calculate and interpret the meaning of the vectors in the TNB, or Frenet, frame

C.9 Graphing and analyzing functions – sketch or predict appearance of the graph of a function or curve based on a formula or other description; sketch or describe level sets of a function; use computer software to examine shapes of graphs and level sets

C.10 Limits and continuity – evaluate limits of functions of several variables; explain how limits in this context differ from the single-variable case; determine continuity from a graph or a formula

C.11 Partial derivatives – compute and interpret the partial derivatives and gradient of a function of 2 or 3 variables; apply and explain equality of mixed partial derivatives, including sufficient conditions for such equality to hold

C.12 Linearization – find tangent vectors, tangent lines, and tangent planes; use these to approximate curves and surfaces near a point

C.13 Optimization – use higher derivatives to collect data about the shape of the graph of a function; find and classify critical points; use Lagrange multipliers to find constrained critical points
C.14 **Double integrals** – explain how integrals are defined, using Riemann sums, in several variables, and estimate integrals based on this definition

C.15 **Iterated integrals** – compute proper double integrals using iteration; find new limits when order of integration is changed

C.16 **Applications of integrals** – use integrals to find mass, center of mass and other geometric quantities

C.17 **Parametrized surfaces** – find and use parametrizations of surfaces to compute tangent planes and surface area

C.18 **Triple integrals** – set up and evaluate integrals over regions of space; change order of integration when useful; apply triple integrals to compute geometric quantities

C.19 **Change of Coordinates** – compute and interpret the Jacobian determinant of a coordinate change function; justify formulas for integration in polar, spherical, and cylindrical coordinates

C.20 **Vector fields** – sketch vector fields, use computer to visualize, model physical phenomena

C.21 **Line integrals** – set up and evaluate line integrals of scalar fields or vector fields; interpret results; apply Fundamental Theorem in case of conservative fields

C.22 **Green’s theorem** – explain what the boundary of a region in $\mathbb{R}^2$ is; explain how Green’s theorem relates to FTC; use Green’s theorem to evaluate integrals, including finding area.

C.23 **Differential operators** – compute and interpret divergence and curl of a vector field; explain how differential operators (div, grad, curl) are related

C.24 **Surface integrals** – set up and evaluate surface integrals of scalar fields and vector fields (flux); explain the role of orientation in flux integrals

C.25 **Stokes’ and divergence theorems** – explain the meaning and significance of the Divergence Theorem and Stokes’ Theorem; use these to convert integrals between various forms

**General standards**

G.1 Participation
G.2 Algebra/Early Calculus
G.3 Homework
Course Policies:

- Exam makeups must be approved beforehand with documentation of a valid university sanctioned excuse.
- Make sure you regularly check on d2l for any changes in due dates. I reserve the right to change dates based on our progress in class. Usually, this will mean allowing more time, not less.
- Bring your university ID card to all exams.
- Arrive on time (early) and prepared to participate in class.
- DO NOT use your cell phone in class. This especially includes texting. Phones should be set to silent mode and put away during class time. I will confiscate your cell phone for the duration of the class period if I see you use it during class. You may NOT use your cell phone as a clock or calculator on quizzes or exams.

Approximate Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Aug 27</td>
<td>11.1 – parametric equations</td>
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<td></td>
<td>11.2 – arc length and speed</td>
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<td>2</td>
<td>Sept 3</td>
<td>11.3, 11.4 – polar coordinates</td>
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<td></td>
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<td>11.4, 11.5 – conic sections</td>
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<td>3</td>
<td>Sept 10</td>
<td>12.1, 12.2 – vectors, 2D and 3D</td>
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<td>12.3, Review – dot product</td>
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<td>4</td>
<td>Sept 17</td>
<td>12.4 – cross product</td>
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<td>12.5 – planes in 3D</td>
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<td>5</td>
<td>Sept 24</td>
<td>12.6, 12.7 – survey, cylindrical</td>
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<td>12.7, 13.1 – spherical, v-v functions</td>
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<td>6</td>
<td>Oct 1</td>
<td>13.2, 13.3 – calculus v-v</td>
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<td>13.4, 13.5 – curvature, motion</td>
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<td>7</td>
<td>Oct 8</td>
<td>14.1, 14.2 – 2 or more variables</td>
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<td></td>
<td>14.3, Review – partial derivatives</td>
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<td>8</td>
<td>Oct 15</td>
<td>14.4 – tangent planes</td>
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<td></td>
<td></td>
<td>14.5 – gradient, directional der</td>
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<td>9</td>
<td>Oct 22</td>
<td>14.6, 14.7 – chain rule, optimization</td>
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<td>14.8 – Lagrange multipliers</td>
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<tr>
<td>10</td>
<td>Oct 29</td>
<td>15.1, 15.2 – integration 2D</td>
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<tr>
<td>11</td>
<td>Nov 5</td>
<td>15.3, 15.4 – triple integrals</td>
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<tr>
<td></td>
<td></td>
<td>15.4, 15.5 – polar, cylindrical, spherical</td>
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<tr>
<td>12</td>
<td>Nov 12</td>
<td>15.6, 16.1, 16.2 – vector fields, line integrals</td>
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<td></td>
<td></td>
<td>16.3 – conservative vector fields</td>
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<tr>
<td>13</td>
<td></td>
<td>Thanksgiving</td>
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<tr>
<td>14</td>
<td>Nov 26</td>
<td>16.4, 16.5 – surface integrals</td>
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<tr>
<td>15</td>
<td>Dec 3</td>
<td>17.1 – Green’s Theorem</td>
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Per SFA policy 5.4, the schedule should reflect that there is (1) an amount of student work per credit hour that reasonably approximates not less than one hour of class or direct faculty instruction and two hours of out-of-class student work per week for fifteen weeks over a long semester, or the equivalent amount of work over a different amount of time; or (2) at least an equivalent amount of work as outlined in item 1 above for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours. So, for instance, a 3 credit hour face-to-face course in the fall or spring term should approximate 150 minutes of classroom time and at least 6 hours of out-of-class work per week for fifteen weeks.

For this course, we have 225 minutes of classroom time each week AND approximately 8 hours of out-of-class work per week.

Student Learning Outcomes (SLO):
At the end of MTH 333, a student who has studied and learned the material should be able to:
1. Perform and interpret the standard vector operations. [PLO: 2]
2. Calculate and interpret the arc length, unit tangent vector, curvature, and principal unit normal of vector-valued functions parameterized either by time or arc length. [PLO: 2]
3. Demonstrate an understanding of the connection between the gradient of a multivariate function, directional derivatives, and tangent planes. [PLO: 1]
4. Set up, manipulate, transform, and interpret multiple integrals to solve mathematical and real-world problems. [PLO: 2,4]
5. Calculate line integrals in vector fields and relate these integrals to the notions of circulation and flux. [PLO: 2,4]
6. Use Green’s Theorem to connect the flux of a vector field to its divergence and the circulation to the curl. [PLO: 1,2]
7. Calculate surface integrals and relate them to real-world applications. [PLO: 2,4]
8. Generalize Green’s Theorem in the plane to Stokes’ Theorem and the Divergence Theorem on surfaces. [PLO: 1,2]

Program Learning Outcomes (PLO):
Students graduating from SFASU with a B.S. Degree and a major in mathematics will:
1. Demonstrate comprehension of core mathematical concepts. [Concepts] (notion of theorem, mathematical proof, logical argument)
2. Execute mathematical procedures accurately, appropriately, and efficiently. [Skills] (calculus, algebra, routine, nonroutine, applied)
3. Demonstrate competence in using various mathematical tools, including technology, to formulate, represent, and solve problems. [Problem Solving] (calculus tools, algebra tools, applied tools, nonstandard problem solving)

Acceptable Student Behavior
Classroom behavior should not interfere with the instructor’s ability to conduct the class or the ability of other students to learn from the instructional program (see the Student Conduct Code, policy D-34.1).
Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic or other penalties. This prohibition applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom. Students who do not attend class regularly or who perform poorly on class projects/exams may be referred to the Early Alert Program. This program provides students with recommendations for resources or other assistance that is available to help SFA students succeed.

**Academic Integrity (A-9.1)**

Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.

**Definition of Academic Dishonesty**

Academic dishonesty includes both cheating and plagiarism. Cheating includes but is not limited to (1) using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class; (2) the falsification or invention of any information, including citations, on an assigned exercise; and/or (3) helping or attempting to help another in an act of cheating or plagiarism. Plagiarism is presenting the words or ideas of another person as if they were your own. Examples of plagiarism are (1) submitting an assignment as if it were one's own work when, in fact, it is at least partly the work of another; (2) submitting a work that has been purchased or otherwise obtained from an Internet source or another source; and (3) incorporating the words or ideas of an author into one's paper without giving the author due credit.

Please read the complete policy at [http://www.sfasu.edu/policies/academic_integrity.asp](http://www.sfasu.edu/policies/academic_integrity.asp)

**Withheld Grades Semester Grades Policy (A-54)**

Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average.

The circumstances precipitating the request must have occurred after the last day in which a student could withdraw from a course. Students requesting a WH must be passing the course with a minimum projected grade of C.

**Students with Disabilities**

To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to [http://www.sfasu.edu/disabilityservices/](http://www.sfasu.edu/disabilityservices/).