SE102: Multivariable Calculus

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DGIST

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GitHub: **github.com/HyosangKang/MultivariableCalculus**

Class Room: E7-223(Lec), E3-318(Recit)
Class Hours: (Lecture) Mon, Thr 16:30 - 18:00
(Recitation) Thr 12:30 - 14:30

Course Description

Multivariable Calculus is a mathematical subject on differentiation and integration of functions with several variables. The multivariable functions are used in every scientific research. In this course you will understand the key concepts on multivariable functions, multiple integrals, partial derivatives, and learn the basic skills on how to compute them symbolically and numerically by Matlab. You will also learn how to visualize your computations. Meanwhile, you will be trained how to initiate a scientific research from a real-life question.

Course Objectives

A successful student will be able to

- understand the mathematical concepts on multivariable calculus;
- write mathematical statements on differentiation and integration of multivariable functions correctly;
- draw graphs of multivariable functions and compute formulas on differentiation and integration using Matlab;
- transform a real-life question into a mathematical research question;
- design a mathematical model for solving questions from non-mathematical area.

Prerequisites and Texts

There is no prerequisite for this course. The lecture note is available here. Please be aware that the contents and the ordering of the topics in the lecture note is subject to change. There are many traditional textbooks on Multivariable Calculus, which would be helpful as references.

- James Stewart, **Calculus**
- James Stewart, **Multivariable Calculus** (contains only multivariable part)
- Deborah Hughes-Hallett, Andrew M. Gleason, et al., **Calculus: Single and Multivariable**
- Susan J. Colley, **Vector Calculus**
- Jerrold E. Marsden, **Basic Multivariable Calculus**

Assessments and Grading

The following table is the schematic of the final grade.

Total Score($\geq$)	90	80	75	65	55	50	40	30	25	15	5	0
Grade	A+	A0	A-	B+	B0	B-	C+	C0	C-	D+	D0	D-

The total score is composed of

- Midterm (30%)
- Final (30%)
- Homeworks (15%)
- Project (15%)
- Class participation (10%)

Exams

Midterm and final will be given during the 8th and 16th weeks of the semester. Exact dates of the exams will be announced at DGIST portal website 1 or 2 weeks prior. Exams will start at the same time but in different places as other sections of Multivariable Calculus. The questions of the exams will different from the other sections. You must attend both exams, or you will fail the course. (see the policy on missing an exam below.)

You will be asked to present your understanding of the materials covered in the course, by writing correct mathematical statements in a logical way in order to get the full mark. For incorrect solutions, partial points will be given according to the grading scheme provided on an exam sheet.

Homework

There will be a weekly homework. You must submit homework electronically to LMS on time. **No late submission is allowed.** You must convert your work into a single pdf file before upload. If the homework is illegible or the file is broken, it will be graded.

You must complete the assignment on your own effort. If there is any suspicion of plagiarism such as copying from other students' work or textbooks, it will be rigorously judged by the policy on academic integrity.

Project

During the semester, you should carry out a research project. The topic of projects will be given in the beginning of the semester. You must carefully design your research plan and how to make use of mathematical concepts. Your work will be evaluated by the **final report** and the **oral presentation** at the end of semester. The work must be written in the **1-page** report. If there are supplement materials, you should provide them in a zip file. You must summarize your work in the **2-minute** oral presentation. Not only the report and oral presentation should be concise, but also they must be **dense**: the amount of implicit work will be evaluated too.

Class Participation

The class participation counts number attendances in class, including **both** lecture and recitation. 1% of the grade will drop per missing or late show-up. **If you miss or late to class more than 10 times, you will fail the course.** You must provide an official documents (such as a doctor's note, or an organization's official letter, etc) **within a week** of absence to get an exemption.

Class Schedule

Lecture

There are two 75-minute lectures every week. Students' should read the pre-announced contents of the lecture note before each lecture. In the lecture, there will be a brief overview of the materials (I will not review the details from the lecture notes.), and we will spend the most of time for discussion using the hand-outs, which will contains key questions to understand concepts and topics of the week.

Most of the course materials will be written in **English**. Some part of the lecture will also be given in English, and the usage of English in class will increase over the semester.

Recitation

There will be one 50-minute recitation sessions every week. Due to the room capacity, there will be two sessions held in a row in the same place: one starts at Thr 12:30 and the other starts at Thr 13:30. The sessions will separated based on the amount of experiences in programming.

Weekly schedule

The numbers on each topic are used in Figure 1.

Week 01, 09/02 - 09/06

- (Lecture) (1) Vectors and matrices
- (Recitation) Basic Matlab commands I

Week 02, 09/09 - 09/13

- (Lecture) (2) Multivariable functions and their graphs
- (Recitation) Basic Matlab commands II
- **Korean Harvest day on 9/12**

Week 03, 09/16 - 09/20

- (Lecture) (3) Multiple integrals I
- (Recitation) Matlab programming I

Week 04, 09/23 - 09/27

- (Lecture) (3) Multiple integrals II
- (Recitation) Matlab programming II

Week 05, 09/30 - 10/04

- (Lecture) (4) Partial derivatives
- (Recitation) Project overview
- **National foundation day on 10/3**

Week 06, 10/07 - 10/11

- (Lecture) (5) Vector fields
- (Recitation) Computations on vectors

Week 07, 10/14 - 10/18

- (Lecture) (6) Jacobians
- (Recitation) Review

Week 08, 10/21 - 10/25 Midterm Exam

Week 09, 10/28 - 11/01

- (Lecture) (7) Line integrals
- (Recitation) Computations by Matlab I

Week 10, 11/04 - 11/08

- (Lecture) (8) Green theorem
- (Recitation) Computations by Matlab II

Week 11, 11/11 - 11/15

- (Lecture) (9) Surface integrals
- (Recitation) Project feedback I

Week 12, 11/18 - 11/22

- (Lecture) (10) Stokes and Gauss theorem
- (Recitation) Project feedback II

Week 13, 11/25 - 11/29

- (Lecture) (11) Lagrange multiplier I
- (Recitation) Presentation I

Week 14, 12/02 - 12/06

- (Lecture) (11) Lagrange multiplier II
- (Recitation) Presentation II

Week 15, 12/09 - 12/13

- (Lecture) (12) Improper Integrals
- (Recitation) Review

Week 16, 12/16 - 12/20 Final Exam

The Figure 1 below shows the relationship between weekly topics. Arrows indicate hierarchy between topics and dashed lines indicate that two topics are weakly related.

The weekly schedule is not strict and nor it indicate we cover only one topic every week. We will go back and forth the materials in the text whenever related topics are necessary.

For example, the key subject of the course is the **Stokes' theorem** in (10), and this is also important in *SE106* Electromagnetic. However, we cover this topic in the end of the semester, whereas it is used in *SE106* Electromagnetic at the beginning semester. Thus we may introduce some surface integrals while we study multiple integrals.

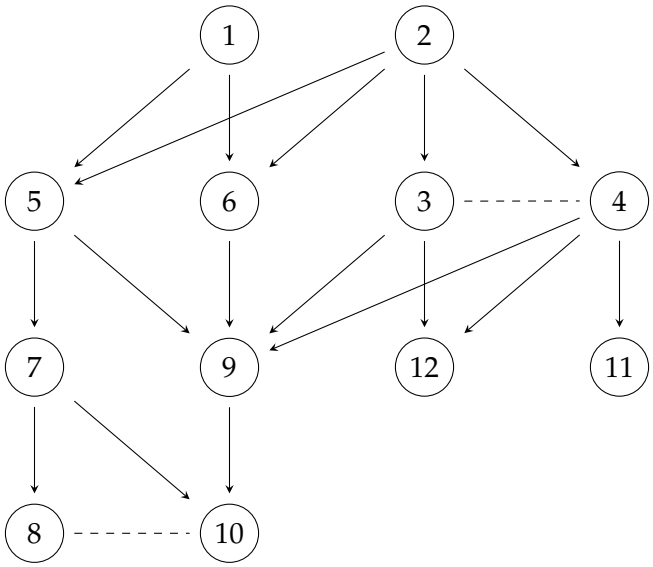

Figure 1: Relationship between topics in Multivariable Calculus

Course Policies

Academic Integrity

You are expected to maintain the highest honor of your action during the semester. You must respect instructors, class-assistants, and fellow students. Any event of misconducts shown below will automatically result in the failure the course.

- **Cheating in exam**. If you use any of unauthorized documents and devices during the exam inside or outside of the exam site (and even in a private area), you will be asked to leave the exam immediately, and fail the course.
- **Plagiarism.** The course will maintain the highest standard on plagiarism. If your homework or project report is copied from other sources such as fellow students' works or internet websites, the score will be marked as 0. If you commit plagiarism unintentionally once, there will be a warning. If you commit plagiarism **twice**, you will fail the course. Any intentional plagiarism will automatically lead to the failure of the course.
- **Forging an official documents.** If you make a fraud excuse for missing a class, missing an exam, or late homework, you will automatically fail the course without warning.

Missing an exam

In the case of emergency during the exam such as hospitalization or attending a family funeral, you must report to the instructor as soon as possible. You will have a make-up exam (without panalty) if you provide an official document. If you miss midterm or final exam without any notification **within a week** or an official reason, you will fail the course.