University of Waterloo

Department of Mechanical and Mechatronics Engineering

MTE 203 – Advanced Calculus

Fall Term, 2018

Instructor: **Prof. Patricia Nieva**

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Contact me: Stop by my office, email me, or call me
Office hours: Mondays 4:30pm – 5:30pm

Schedule

Schedule	Dates	Day	Time	Room
Lectures	Sep 7 to Dec 3	Monday	11:30 am to 12:20pm	E5 3101
		Wednesday	11:30 am to 12:20pm	E7 3353
		Friday	10:30am to 11:20am	E5 3101
Makeup Lectures	Sep 25, Oct 11[1] and Nov 6	Tuesday	11:30 am to 12:30pm	E5 3101
No Lecture on Sep 19	Moved to Sep 11	Tuesday	11:30 am to 12:20pm	E5 3101
Lecture Oct 12	Wednesday Schedule	Friday	11:30 am to 12:20pm	E7 3353
Extra Lecture[2]	20-Nov	Tuesday	11:30 am to 12:30pm	E5 3101
Tutorials – 001	Starting on Sep 11[3]	Tuesday[3]	1:30 pm to 2:20pm	MC 4058
Tutorials – 002	Starting on Sep 11[3]	Tuesday[3]	2:30 pm to 3:20pm	MC 4058
Matlab - Lab 1	13-Sep	Thursday	5:30pm to 8:30pm	CPH 1346
Matlab - Lab 2	04-Oct			
Matlab - Lab 3	18-Oct			
Project 1 Work Time	08-Nov			
Project 2 Work Time	29-Nov			
Office Hours	Starting on Sep 10	Monday	4:30pm - 5:30pm	E3X 4115
Midterm Exam	2018-10-23 (Tentative)	Tuesday	TBD	TBD

[1] No tutorials on Week 1, Week 8 and Week 14
[2] Required to schedule an Exam Practice Session (offered by the instructor)
[3] Tutorials on Week 6 are on Thursday, Oct 11 (Tuesday schedule)

Support Tutors

Alena Gracheva: Office Hours: Tuesdays 4:30pm - 5:30pm, E5-3051, agracheva@uwaterloo.ca
Apra Chakraborty: Office Hours: Thursdays 4:30pm - 5:30pm, E5-3051, a6chakraborty@uwaterloo.ca

Tutors will provide support during tutorial and will help with lab reports, project reports, and exams grading. Questions about the course concepts, expectations, etc., should be directed to the instructor.

Course Objectives

The goal of this course is the mathematical description of phenomena that vary in 2 and 3 dimensions including:

- Scalar functions
- Vector functions
- Derivatives
- Integration

By the end of this course you should

- Be able to apply the course concepts to physical systems, for example describing position, velocity and acceleration in 3D space
- Be comfortable with the notation used for multivariable calculus, e.g. ∂, ∇, $\oint$
- Be able to use MATLAB to solve engineering problems requiring multivariable calculus

Required Texts

- ***Calculus for Engineers*, D. W. Trim, 4th Edition,** Prentice Hall, 2008
  This is the same textbook that is used for Calculus in 1st year.
- ***Mathematical Handbook of Formulas and Tables*, 5th Edition M. R. Spiegel, Schaum's Outline Series,** McGraw-Hill, 2017
  You are allowed to bring an unannotated copy of this book to your MTE 203 midterm and final exams.

Optional

- ***i-Clickers***
  Can be purchased at the bookstore

Communication:

The MTE 203 site in **UW LEARN** will provide ongoing information regarding our course such as your grades, important dates, course notes, assignments, etc. Also, you should check your email box regularly since the UW LEARN mail may also be used by the instructor or tutors to communicate supplementary information about the course.

Student Responsibilities

You are expected to behave in class with engineering professionalism. This involves:

- Attendance to lectures and tutorials
- Read assigned textbook material before each lecture
- Submit MATLAB lab worksheets and reports on time
- Using background knowledge from your following past courses: linear algebra (MATH 115), calculus 1 (MATH 116), calculus 2 (MATH 118), and ordinary differential equations (MTE 202)
- Setting aside at least two hours per week to work on your homework assignment before tutorials

Course Requirements

Assignments

A total of 11[1] homework assignments and their respective solutions will be posted on the course website each Friday afternoon except for weeks 8 and 14[2]. As a policy of the Mechanical Engineering Department, **Homework assignments are not graded**. Students are expected to develop the independence and initiative to study on their own. You are strongly encouraged to try and solve the problems on your own before looking at the solutions. Keep in mind that homework is assigned to help you learn and keep up with the course material. The assigned problems **are only the minimum necessary** to master the material. You are also encouraged to do additional problems from the text for practice.

Help with assignments will be provided during tutorials and TAs office hours. If you need extra help, please set up an appointment, email me or stop by my office.

MATLAB Laboratories

The three MATLAB laboratories will introduce you to the MATLAB software and will use some of its features to illustrate concepts from MTE 203. After these introductory labs, you will be able to use MATLAB not only for MTE 203 but for other courses (such as MTE 204 and SYDE 252) and labs throughout your undergraduate program. **All three laboratories are mandatory.**

All three laboratories will be held on the **Multimedia Lab (CPH 1346)** on the dates and times assigned below.

[1] On Friday September 7, we will post a short review homework assignment containing a very brief review of vectors. Please, look for "Homework 1.1" in your practice tab.

[2] On the Wednesday of weeks 7 and 13 we will post exam practice problem sets (including solutions) in addition to the homework assignments.

You will be completing a worksheet during all Labs 1-3. These are due at 4:30 pm the following day in the Dropbox on UW- LEARN.

Lab Dates and Times:

Lab 1:	Introduction to MATLAB (Week2)	(Sep 13, 5:30pm – 8:30pm)
Lab 2:	3D Graphing and Contour Plotting (Week 5)	(Oct 4, 5:30pm – 8:30pm)
Lab 3:	Using the Symbolic Toolbox (Week 7)	(Oct 18, 5:30pm – 8:30pm)

Projects

There will be two design projects during this term. Solutions should be developed using MATLAB and be based on the analytical theory developed in class. Each student is expected to work on these projects and present their results **INDIVIDUALLY**. Students are also expected to present a detailed mathematical analysis, techniques used, and results in a concise, clear, typed, and professional way.

Both project descriptions will be posted in UW-LEARN on the date assigned below. Project reports are mandatory and must be uploaded in the corresponding DROPBOX created in LEARN for that purpose by 11:59pm during the specified deadline. Make sure that all pages are saved into a single file (word or pdf) and that you also upload all the MATLAB m-files required by the project.

Projects Schedule:

Project 1:	Assigned on Friday, Nov 02 (Week 9);	Due on Friday, Nov 12 (Week 1)
Project 2:	Assigned on Friday, Nov 23 (Week 12);	Due on Monday, Dec 03 (Week 14)

Two “work time” sessions offered in November 08 and in November 29 will be offered for you to work in your projects under TA supervision.

About late submissions and pick up of marked project reports

Project reports are to be submitted on-line using the dropbox available for that purpose. Project report feedback and grades will be available in LEARN after two weeks of the date of your submission. Late project reports can be handed into the Mechatronics Undergraduate Office during the hours of 8:30am to 12:00pm and from 1:00pm to 4:30pm. Make sure that Ms. Elizabeth Skibicki, Undergraduate Advisor/Coordinator, signs for the project report and gives it a time and a date.

Late Policy: Late project reports will have 25% of their mark deducted for each day or part of a day that they are late.

Grace Days: You have a total of 4 working days (regular M-F lecture days) as grace days for the Matlab worksheets and projects

Exams

Midterm exam: **2.0 hours** exam
Final exam: **2.5 hours** exam

For the midterm and the final exams, you are allowed to bring:

- Your Mathematical Handbook of Formulas and Tables by M. R. Spiegel **(no annotations allowed)**.
- Pencil, eraser, sharpener and a scientific calculator approved by the UW Faculty of Mathematics (or equivalent).
- No assignments, class notes or any other papers are allowed (blank sheets will be provided).
- No telecommunication devices will be permitted (e.g., cell phones or any other wireless devices).

Grading Policy

The approximate grade breakdown for the course will be:

3 MATLAB Worksheets (1%,1.5%,1.5%)	4%
2 MATLAB Projects (7.5% each)	15%
Midterm Exam	36%
Final Exam	45%
TOTAL	100%

A bonus of 5% maximum will be assigned **for at least 75% of clicker questions answered** (see details in the next page).

Clickers

We will use clickers throughout the term to help aid and assess your understanding of the course material. Using clickers is a lot of fun and answering the clicker questions will allow you to show me what you understand without having to raise your hand and identify yourself. The clicker questions will also allow you to review on the spot your understanding of the material being covered. **A bonus of 5%** maximum will be assigned **for at least 75% of questions answered**. Hence, there is no need to get stressed about your number of correct clicker answers.

Clickers are required and are available at the University Bookstore. To register your o-clicker use the module created in the MTE 203 site in Waterloo LEARN.

For information on how to use your clicker go to:

https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/educational-technologies/all/clickers

Frequently asked questions about Clickers *(Modified from Biology)*

What happens if I don't get a clicker / forget my clicker? / miss a clicker session?

The grade component (5%) associated with clicker sessions is quite small. It is awarded for participation rather than correct answers. The grading scheme is set such that forgetting your clicker or missing a few classes will not impact on your grade.

What do I have to do to get the full 5% participation grade?

To obtain the full 5% for clicker participation, you must participate in at least 75% of the clicker questions. Participation at less than 75% will be pro-rated accordingly.

Why should I participate in clicker sessions when they count for so little?

Clicker sessions provide an anonymous, zero-risk way of demonstrating your grasp of course material, to yourself and to me. When response to a clicker question reveals a misconception in a substantial proportion of the class, we will have the opportunity to go over that material. If you are choosing incorrect answers more frequently than the rest of the class, you may want to seek some extra help. That is up to you - we will not track how you are answering clicker questions.

If you do not participate in clicker sessions, your only opportunity for self-feedback is exams, which are neither anonymous nor risk-free.

Course Schedule

This schedule is subject to changes at any time. Please login frequently to UW LEARN for updates.

WEEK	DATE	LECTURE	TOPIC	READING
1	7-Sep	Le1	Introduction to MTE 203, Vectors and 3D Analytical Geometry	Handout 1, Trim - 11.1, 11.3
2	10-Sep	Le2	Lines in 3D	Trim - 11.5
	11-Sep	Le3	Planes in 3D, Calculation of Distance in 3D	Trim - 11.5, 11.6
	11-Sep	Tu1.1	Application Problems	Le1 - Le2
	12-Sep	Le4	Application Problems, Cylinders and Quadric Surfaces	Trim - 11.6, 11.2
	13-Sep	MLab1	Introduction to MATLab (material for MTE 203, MTE 204 and SYDE 252)	References at UW-LEARN
	14-Sep	Le5	Vector Functions, Path and Curves	Trim - 11.2, 11.10
3	17-Sep	Le6	Differentiation and Integration of Vector Functions (Disp.,Vel., Acc.)	Trim - 11.9, 11.13
	18-Sep	Tu2	Application Problems (Hw1)	Le3 - Le5
	19-Sep		**No lecture - Moved to September 25**	
	21-Sep	Le7	Arc Length and Arc Length Parameter	Trim - 11.11
4	24-Sep	Le8	Unit Tangent Vector, Curvature and Unit Normal Vector	Trim - 11.11
	25-Sep	**Le9**	**Binormal Vector and Applications**	**Trim - 11.12**
	25-Sep	Tu3	Application Problems (Hw2)	L6 - Le8
	26-Sep	Le10	Application Problems: Parametrization, Frenet Vector-Frame	Trim - 11.1 to 11.12
	28-Sep	Le11	Tangential and Normal Comp of Acceleration, Other Curvature Formula	Trim - 11.13
5	1-Oct	Le12	Multivariable Functions, Contour Maps and Level Surfaces	Trim - 12.1
	2-Oct	Tu4	Application Problems (Hw3)	Le9 - Le11
	3-Oct	Le13	Partial Derivatives of a Function of 2 Variables	Trim - 12.3
	4-Oct	MLab2	Graphing and Contour Plotting	Lab Worksheet 1
	5-Oct	Le14	Higher Order Partial Derivatives and Applications	Trim - 12.5, 12.7
6	**8-Oct**		**Happy Thanksgiving!**	
	10-Oct		**Fall Study Day**	
	11-Oct	Le15	Chain Rule and Partial Differentiation	Trim - 12.5 -12.6
	11-Oct	Tu5	Application Problems (Hw4)	Le12 - Le14
	12-Oct	Le16	Chain Rule and the tree diagram (application examples)	Trim - 12.6
7	15-Oct	Le17	Directional Derivative and Gradient Vector	Trim - 12.8
	16-Oct	Tu6	Application Problems (Hw5)	Le15 - Le17
	17-Oct	Le18	Properties of the Gradient Vector, Tangent Lines and Planes	Trim - 12.4, 12.8, 2.9
	18-Oct	MLab3	Using the Symbolic Toolbox	Lab Worksheet 2
	19-Oct	Le19	Midterm Exam Review	**Le1 - Le18**
	TBD	**Extra**	**Midterm Exam Review - Extra Lecture**	**Le1 - Le19**
8	**23-Oct**		**MIDTERM EXAM**	**Le1 - Le19**

WEEK	DATE	LECTURE	TOPIC	READING
9	29-Oct	Le20	Relative Maxima and Minima	Trim - 12.10
	30-Oct	Tu7	Application Problems	Le20 - Le21
	31-Oct	Le21	Absolute and Constrained Maxima and Minima	Trim - 12.11
	2-Nov	Le22	Constrained Maxima and Minima and Lagrange Multipliers	Trim - 12.12
10	5-Nov	Le23	Double Integrals: Volume	Trim - 13.1, 13.2
	6-Nov	Le24	Double Integrals: Polar Coordinates, Application to Areas	Trim - 13.2, 13.7
	6-Nov	Tu8	Application Problems (Hw7)	Le21 - Le22
	7-Nov	Le25	Triple Integrals: Cartesian Coordinates	Trim - 13.8
	8-Nov		Project 1 - Work Time	
	9-Nov	Le26	Triple Integrals: Cylindrical and Spherical Coordinates	Trim - 13.11, 13.12
11	12-Nov	Le27	Triple Integrals and when to use them	Trim - 13.8 - 13.12
	13-Nov	Tu9	Application Problems (Hw8)	Le23 - Le26
	14-Nov	Le28	Line Integrals	Trim 14.2
	16-Nov	Le29	Vector Fields, Line Integrals Involving Vector Functions	Trim 14.1, 14.3
12	19-Nov	Le30	Fundamental Theorem for Line Integrals	Trim - 14.4
	20-Nov	**Le31**	**Potential and Conservative Fields, Green's Vector Theorem**	**Trim 14.5, 14.6**
	20-Nov	Tu10	Application Problems (Hw9)	Le27 - Le29
	21-Nov	Le32	Green's Vector Theorem and Areas	Trim 14.6
	23-Nov	Le33	Surface Area and Surface Integrals Involving Vector Functions	Trim 13.6, 14.7
13	26-Nov	Le34	Divergence Theorem, Solving Problems with Fundamental Theorems	Trim - 14.4 - 14.9
	27-Nov	Tu11	Application Problems (Hw10)	Le30 - Le33
	28-Nov	Le35	Curl and Stoke's Theorem	Trim - 14.9, 14.10
	29-Nov		Project 2 - Work Time	
	30-Nov	**Le36**	**Practice Problems**	**Le20 - Le35**
14	3-Dec	**Extra**	**Practice Problems**	**Le20 - Le35**
	TBD		**FINAL EXAM**	**Le20 - Le36**

Faculty of Engineering Course Responsibilities

Courses offered in the Faculty of Engineering place responsibility on the Faculty of Engineering, the instructor and teaching team and all of the students. Many of these responsibilities are described at the first lecture or captured in the policies of the University.

(https://uwaterloo.ca/engineering/current-undergraduate-students/academic-support/course-responsibilities)

Attendance Policy

Any illness or circumstances that prevent you from studying for more than a few days should be reported to your MTE academic advisor Elizabeth Skibicki (eskibicki@uwaterloo.ca). If you miss a deadline for health reasons, a Verification of Illness from UW's Health Services should be submitted to your academic advisor.

https://uwaterloo.ca/mechanical-mechatronics-engineering/current-students-mechatronics-engineering/academic-issues.

About academic Integrity, grievance, discipline, appeals and notes for students with disabilities

When you submit an assignment to your course instructors or tutors and/or submit a file to a UW-LEARN dropbox, you are also indicating that you understand and have complied with all Academic Integrity and related UW policies.

Worksheets and projects assigned in this course should represent your individual work completed during the current term, except for any assistance explicitly indicated in the course UW-Learn environment.

As an example, the **penalty for "plagiarism/cheating on assignments** (e.g., copying) in courses with numeric grades" (assuming no previous academic offences in any course) includes a letter placed in your file describing the offence, zero on the assignment, and 5% subtracted from your overall course grade. See http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm for more examples.

Academic Integrity:

In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

Check www.uwaterloo.ca/academicintegrity/ for more information.

Grievance:

A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4 (www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline:

A student is expected to know what constitutes academic integrity.

Check www.uwaterloo.ca/academicintegrity/ to avoid committing an academic offence, and to take responsibility for your actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean.

For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm.

For typical penalties refer to the Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals:

A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground.

A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals), www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities:

The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.