ME201 ADVANCED CALCULUS
Winter 2018

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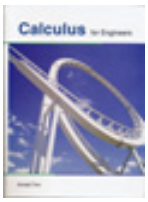
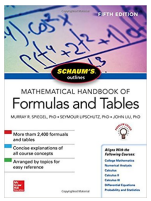
Web Page: **http://www.mhtlab.uwaterloo.ca/courses/me201/index.html**

bookmark this page: you will be expected to use this page regularly for things such as: important dates, course notes, assignments, etc.

Textbooks:



Calculus for Engineers
D.W. Trim
Prentice-Hall, 4th ed., 2008
(same as first year)



Mathematical Handbook of Formulas and Tables, Fifth Edition
M.R. Spiegel, S. Lipschutz, and J. Liu
Schaum's Outline Series, 2017

Supplementary Books:

1) *Advanced Calculus* by R. Wrede and M.R. Spiegel, Schaum's Outline Series

2) *Ebook Schaum's Outline of Advanced Calculus, Third Edition*

Outline:

Chapter 11 - Vectors and Three Dimensional Analytic Geometry
Chapter 12 - Differential Calculus of Multivariable Functions
Chapter 13 - Multiple Integrals
Chapter 14 - Vector Calculus

Assignments: Problems will be assigned weekly, but it is a policy of Mechanical and Mechatronics Engineering that weekly assignments in all courses are not marked. Students are expected to develop the independence and initiative to study on their own. Solutions are available for all assigned problems on the ME201 web page at (http://www.mhtlab.uwaterloo.ca/courses/me201/assign.html). It is important that you keep up with the material by doing the problems - **REGULARLY, ON YOUR OWN, BEFORE LOOKING AT THE SOLUTIONS.** To do well in exams, you must develop problem solving skills week by week throughout the term. These skills cannot be developed by cramming lecture notes at the last minute or looking at solution sets for a few hours before exam time. There is simply too much material to learn in this way. Lectures will also mean more to you if you are keeping up as new material is presented.

Tutorials: T.A.'s will work through selected problems and answer questions about lecture material and assignments. They will also provide individual help.

Assessment:

Project	15%
Midterm	35%
Final	50%

For the midterm and final exams you are permitted to bring your *Mathematical Handbook of Formulas and Tables* plus a crib sheet consisting of one 8 1/2 $\times$ 11 sheet of paper; one side only. The preparation of a well structured crib sheet will help in the preparation for exams as you assign priority to what is and is not important.

Project

A project will be assigned during the first month of the term. The project will explore the use of mathematics and vector analysis to model the complex problem of backing up a vehicle with a trailer attached. You will work in groups of 3 or 4 students and each group is expected to perform their own measurements, experimental analysis and calculations. The results for your group will be presented in a single, clear, concise report, typed or neatly handwritten. The report should explain the techniques used, summarize the analysis, describe any problems encountered, present the results and provide conclusions. You are expected to provide sufficient detail that clearly demonstrates your understanding of the problem.

This project will be based on qualitative observations and quantitative measurements performed using vehicle and trailer prototypes available in WATiMake, the MME Clinic space in DWE 3509. You are expected to pick up your project kit and perform your general introduction to the lab exercise in the WATiMake lab space. All remaining measurements will be performed using your vehicle/trailer project kit at home or wherever you prefer. Please return the kit to the WATimake lab once all of your measurements have been completed.

- Anyone suspected of copying or cheating will be assigned a grade of zero.
- Your project report must be handed in immediately following the lecture period on the Due Date.
- No extensions will be granted.
- Failure to hand the project in on time will result in a grade of zero for that project group.

	Title	Assigned Date	Due Date	Value
Project :	Backing Up a Trailer Using Vector Analysis	January 26	March 16	15%

ME201 Course Schedule

Week	Days	Topics	Text Sections
1	Jan. 3 - 5	Vectors, Points, Curves & Lines in 3D	11.1, 11.2, 11.3, 11.4
2	Jan. 8 - 12	Vectors and Planes in 3D, Calculation of Distance, Differentiation & Integration of Vectors	11.5, 11.7 11.6 11.9, 11.10
3	Jan. 15 - 19	Tangent Vectors and Arc Length, Curvature and Centripetal Acceleration	11.11 11.12, 11.13
4	Jan. 22 - 26	Introduction Multivariable Functions, Partial Derivatives, Chain Rule	12.1, 12.2 12.3, 12.5, 12.6
5	Jan. 29 - Feb. 2	Gradient and Directional Derivative, Tangent Lines, Tangent Planes	12.4, 12.8 12.9
6	Feb. 5 - 9	Extrema of Functions Least Squares	12.10, 12.11 12.13
7	Feb. 12 - 16	Midterm week - no lectures	
8	Feb. 19 - 23	Study Week - no lectures	
9	Feb. 26 - Mar. 2	Double Integrals, Areas & Volumes from Double Integrals	13.1, 13.2, 13.7 13.3, 13.6
10	Mar. 5 - 9	Triple Integrals, Cylindrical & Spherical Coordinates, Moments of Area, Mass & Volume	13.8, 13.9 13.11, 13.12 13.5, 13.10
11	Mar. 12 - 16	Vector Fields, Gradient, Divergence, Curl Operations and Line Integrals	14.1 14.2 14.3
12	Mar. 19 - 23	Independence of Path, Conservative Force Fields & Surface Integrals	14.4 14.5, 14.7, 14.8
13	Mar. 26 - 30	Divergence Theorem and Green's Theorem	14.9 14.6
14	Apr. 2 - 4	Stoke's Theorem	14.10

ME201 Recommended Problems

Assignment	Week	Section	Problems
1	Jan. 5	11.3	*Assignment #1*
		11.4	Vectors, Vector Operations and
		11.5	Vector Representations
2	Jan. 12	11.6	*Assignment #2*
		11.7	Applications of Vectors and Vector
		11.9	Calculus
		11.11	
3	Jan. 19	11.10	*Assignment #3*
		11.12	Curvature, Acceleration & Partial
		11.13	Derivatives
		12.1	
		12.3	
4	Jan. 26	12.5	*Assignment #4*
		12.6	Chain Rule, Tangent Lines
		12.9	and Tangent Planes
5	Feb. 2	12.4	*Assignment #5*
		12.8	Gradients & Directional Derivatives
6	Feb. 9	12.10	*Assignment #6*
		12.11	Minima & Maxima of Multivariable
		12.13	Functions & Least Squares
7	Mar. 2	13.1	*Assignment #7*
		13.2	Double Integration
		13.3	and Surface Area
		13.6	
		13.7	
8	Mar. 9	13.8	*Assignment #8*
		13.9	Triple Integrals, Volumes,
		13.10	Centroids & Moments
		13.11	
		13.12	
9	Mar. 16	14.1	*Assignment #9*
			Vector Fields
10	Mar. 23	14.2	*Assignment #10*
		14.3	Line Integrals, Conservative Force
		14.4	Fields, Scalar Potential Functions &
		14.5	Green's Theorem
		14.6	
11	Mar. 28	14.7	*Assignment #11*
		14.8	Surface Integrals, Divergence
		14.9	and Stoke's Theorem
		14.10	