VECTOR CALCULUS
MATH 21D, Fall Quarter, 2021
Blake Temple
(Sects B01-B04,B07 CRNs 38772-38775,38778)

TEXT: *Thomas' Calculus, Early Transcendentals, 11th Edition*
(Ch 13,15,16 available on my webpage)
Authors: Weir, Hass and Giordano
Chapters: 15 and 16 (including topics from Chapter 12, 13).
PROFESSOR: Blake Temple, 3148 MSB
Lecture: 198 Young Hall, MWF 2:10-3:00
Office Hours: MWF 3:15-4:15; **e-mail:** temple@math.ucdavis.edu
Class Webpage: http://www.math.ucdavis.edu/∼ temple/MAT21D/

Thursday Discussion Sections: (Handled by TA's)
B01 192 Young, R6-7; **B02** 1020 Wicksn, R5-6; **B03** 1020 Wicksn, R4-5;
B04 7 Wellman, R6-7; **B07** 251 Olsen, R5-6.

GRADING: Midterms I,II=100pts each, Final =200pts.
Midterm I: Monday, October 18, Sections 15.1-15.7
Midterm II: Friday, Nov 19, Sections 13.1-13.4, 16.1-16.6
Final Exam: Friday December 10, 1-3pm, 198 Young Hall

HOMEWORK: Problems/Solutions Posted Online:
https://www.math.ucdavis.edu/ temple/MAT21D
HW will *not be collected*, but there will be a weekly homework
quiz in each Tuesday discussion section covering the homework
from the preceding week. I will use the homework score to (at
most) adjust a grade by + or − according to my judgement.
There will be no makeup of homework or exams.

SYLLABUS

DAY	SECTION	HOMEWORK
WE − Sep 22	**Introduction/15.1**	**15.1**−1, 2, 4, 5, 7, 9, 13, 21, 23, 38
FR − Sep 24	**15.1**	**15.1**−41, 43, 44, 45, 46, 51, 59
MO − Sep 27	**15.2**	**15.2**−2, 3, 7, 9, 11, 12
WE − Sep 29	**15.2**	**15.2**−14, 15a, 17, 19, 24, 33, 34
FR − Oct 1	**15.3**	**15.3**−1, 3, 4, 12, 13, 18
MO − Oct 4	**15.4**	**15.4**−7, 8, 11, 12, 17, 42
WE − Oct 6	**15.5**	**15.5**−2, 3, 4, 11, 13, 15
FR − Oct 8	**15.6**	**15.6**−1, 6, 8, 18, 19, 44, 56
MO − Oct 11	**15.6 − 15.7**	**15.6**−21, 27, 35, 56, 70
WE − Oct 13	**15.7**	**15.7**−1, 4, 6, 8, 12, 15a, 16ab
FR − Oct 15	**Review/Catchup**	
MO − Oct 18	**Midterm I**	
WE − Oct 20	**13.1**	**13.1**−1, 3, 4, 6, 8, 10, 12, 13, 19, 33, 43, 45, 48
FR − Oct 22	**13.2**	**13.2**−1, 2, 3, 5, 7, 11, 18
MO − Oct 25	**13.3**	**13.3**−1, 3, 6, 9, 12, 14, 19, 20
WE − Oct 27	**13.4 (12ed13.4/5)**	**13.4**−2, 3, 9, 11, 19, 21
FR − Oct 29	**16.1**	**16.1**−1 − 8, 10, 17, 18, 29
MO − Nov 1	**16.2**	**16.2**−1, 3, 4, 5, 6, 7, 15, 20, 22, 31, 35
WE − Nov 3	**16.2**	**16.2**−17, 23, 27, 37, 43
FR − Nov 5	**16.3**	**16.3**−1, 2, 3, 7, 9, 13, 19, 37
MO − Nov 8	**16.4**	**16.4**−1, 5, 7, 8, 11
WE − Nov 10	**16.4/5**	**16.4**−15, 19, 22
FR − Nov 12	**16.5**	**16.5**−1, 3, 5, 6, 7, 13, 15, 17, 19, 21, 24, 27
MO − Nov 15	**16.6**	**16.6**−1, 4, 5, 9, 17, 27, 30, 39
WE − Nov 17	**Review/Catchup**	
FR − Nov 19	**Midterm II**	
MO − Nov 22	**16.7**	**16.7**−1, 3, 6, 7
WE − Nov 24	**16.7/8**	**16.7**−8, 13, 17 **16.8**−5, 6, 7
FR − Nov 26	**Thanksgiving**	
MO − Nov 29	**16.8**	**16.8**−8, 14, 16, 26
WE − Dec 1	**Review/Catchup**	
MO − Dec 3	**Review/Catchup**	

Teaching Assistants:

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COURSE DESCRIPTION:

Math 21D *Vector Calculus* describes the calculus of functions whose inputs and outputs depend on more than one variable. Chapter 15 covers multiple integration for scalar functions of two and three variables, with application to finding centers of mass and moments of inertia. Integration in polar, cylindrical and spherical coordinates will be covered, as well as the general formula for changing variables of integration. Chapters 13 and 16 cover vector valued functions (*Vector Fields*). Applications include line integrals, work, conservative vector fields, potential functions, Green's Theorem, the Divergence Theorem and Stokes Theorem. The latter four involve different ways to generalize the Fundamental Theorem of Calculus to vector valued functions.

HISTORY/MOTIVATION: Essentially, MAT21D covers the mathematics required to complete the physical meanings of the three first order operators of classical physics: The *Gradient*, the *Divergence* and the *Curl*. We already know that the Gradient points in the direction of steepest increase of a function. The meaning of the latter two, the *Divergence* as *flux per volume*, and the *Curl* as *circulation per area*, comes from the *Divergence Theorem* and *Stokes Theorem*, respectively; and the mathematics developed in MAT21D is pretty much exactly what is necessary to describe and interpret these theorems with mathematical pre-

cision. The notation of vector calculus in terms of the Gradient, Divergence and Curl was created by Willard Gibbs of Yale University in the late 1800s. By this notation, Gibbs achieved his goal of giving a simple physical expression to Maxwell's equations of electromagnetism (1861). With the vector calculus of MAT21D, Gibbs reduced Maxwell's original twenty equations in twenty unknowns, to the four famous equations we know today. The student who learns the vector calculus of MAT21D has the mathematical background to comprehend Maxwell's theory, and thereby has the opportunity to be a part of one of the greatest true stories of all time—the story of how Maxwell, building on Faraday's idea that electricity and magnetism could be described by electric and magnetic *Vector Fields*, discovered, by pure thought, that light consists of waves propagating in these electric and magnetic fields. To quote from Wikipedia:

Around 1862, while lecturing at King's College, Maxwell calculated that the speed of propagation of an electromagnetic field is approximately that of the speed of light. He considered this to be more than just a coincidence, and commented 'We can scarcely avoid the conclusion that light consists in the transverse undulations of the same medium which is the cause of electric and magnetic phenomena.'

Maxwell's theory of light remained controversial until 1887, when Heinrich Hertz demonstrated that radio waves could be created from oscillating electric and magnetic fields.

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UC-Davis
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