PARTIAL DERIVATIVES AND INFINITE SERIES
MATH 21C, Winter Quarter, 2020
Blake Temple
(Sects B01-B07 CRNs 62662-62668)

TEXT: *Thomas' Calculus, Early Transcendentals, 13th Edition (Text easily found online)*
Authors: Weir, Hass and Giordano
Chapters: 10/11,12,13.1-13.2,14 in 13/11'th editions of Thomas.

PROFESSOR: Blake Temple, 3148 MSB
Lecture: 2205 HARING, MWF 3:10-4:00
Office Hours: MWF 11:15-12:15; **e-mail:** temple@math.ucdavis.edu
Class Webpage: http://www.math.ucdavis.edu/∼ temple/MAT21C/

Tuesday Discussion Sections: (Handled by TA's)
B01 217 OLSON 6-7pm, **B02** 1020 WICKSN 7-8pm, **B03** 108 HOAGLD 5-6pm; **B04** 207 OLSON 6-7pm; **B05** 108 HOAGLD 4-5pm; **B06** 1007 GIEDT 5-6pm; **B07** 1038 WICKSN 5-6pm.

GRADING: Midterms I,II=100pts each, Final =200pts.
Midterm I: Wednesday, February 5, Sections 10.1-10.10/12.1
Midterm II: Wednesday, Mar 4, Sections 12.1-14.5
Final Exam: Friday, March 20, 6-8pm, 2205 HARING

HOMEWORK: Kouba-Solutions Posted On Webpage:

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*
MO – Jan 6	**Introduction/10.1**	**10.1** : 1 – 57, 68, 81, 92, 97, 108, 116, 119
WE – Jan 8	**10.2**	**10.2** : 1 – 35, 45, 50, 51, 59, 60, 67, 87, 90
FR – Jan 10	**10.3**	**10.3** : 1 – 30, 43, 49
MO – Jan 13	**10.4**	**10.4** : 1 – 45, 56 – 60, 63
*s*WE – Jan 15	**10.4 – 5**	**10.5** : 1 – 6,
FR – Jan 17	**10.5**	**10.5** : 40, 41, 42, 51, 63
MO – Jan 20	**Martin Luther King Day**	
WE – Jan 22	**10.6**	**10.6** : 1 – 44, 50, 65, 67
FR – Jan 24	**10.7**	**10.7** : 1 – 25, 42, 56
MO – Jan 27	**10.8**	**10.8** : 1 – 29, 36, 41, 43
WE – Jan 29	**10.9**	**10.9** : 1 – 29, 41, 48
FR – Jan 31	**10.10**	**10.10** : 1 – 17, 25, 29, 61
MO – Feb 3	**12.1 – 12.2**	**12.1** : 1 – 39, 42, 47, 52, 55, 59, 60, 64
WE – Feb 5	**Midterm I**	
12.2 : 1 – 42, 45, 46		
FR – Feb 7	**12.3**	**12.3** : 1 – 23, 25, 27, 31, 32, 49
MO – Feb 10	**12.4**	**12.4** : 1 – 20, 23, 27, 29, 31, 33, 36, 50
WE – Feb 12	**12.5**	**12.5** : 1 – 31, 34, 40, 45, 47, 55, 59, 65, 69
FR – Feb 14	**13.1**	**13.1** : 1 – 17, 28, (Thomas 11′th Ed.)
MO – Feb 17	**Presidents Day**	
WE – Feb 19	**13.2**	**13.2** : 1 – 28, (Thomas 11′th Ed.)
FR – Feb 21	**14.1**	**14.1** : 1 – 25
MO – Feb 24	**14.2**	**14.2** : 1 – 49
WE – Feb 26	**14.3**	**14.3** : 1 – 51, 58, 65, 76, 85,
FR – Feb 28	**14.4**	**14.4** : 1 – 32, 39, 40, 43, 45, 47, 51, 52
MO – Mar 2	**14.5**	**14.5** : 1 – 29, 32, 33, 35
WE – Mar 4	**Midterm II**	
FR – Mar 6	**14.6**	**14.6** : 1 – 18, 20, 21, 26, 28, 56
MO – Mar 9	**14.7**	**14.7** : 1 – 30, 31, 34, 51, 53, 54, 55, 57, 59
WE – Mar 11	**14.8**	**14.8** : 1 – 27, 37, 39,
FR – Mar 13	**Review/Catchup**	

* Only HW problems in the Kouba Solution Set are assigned.

COURSE DESCRIPTION: The first topic of Math 21C is *Power Series*. The second is how to extend Calculus (21A,21B) to more than one dimension. So how are Power Series related to *differential calculus 21A* and *integral calculus 21B*? Answered simply: *Power Series* convert the theory of *functions*, the language of calculus, into the language of *computers*.

• To understand this, recall that the modern theory of calculus starts by viewing the *formulas* of classical mathematics as *functions*. The simplest computable functions are *polynomials* because they are just sums and multiples of powers x^n, e.g., $y = 3x^2+2x+1$ or $y = 4x^4+5x^3+1$, easy to compute. The *classical functions* of mathematics are then polynomials together with $sin(x), cos(x), e^x, ln(x)$ and all their combinations. In the subject of calculus, classical functions are viewed as a special case of a general function $y = f(x)$, defined as any "input-output machine" that inputs real numbers x and outputs real numbers $y = f(x)$. Functions are *extremely general* because input-output machines can be defined by pretty much any description expressible in words–by formulas, by geometry, by data output–but most importantly of all, by solutions of *differential equations*.

• The language of "functions" was first invented to express the great discovery of calculus, the Fundamental Theorem of Calculus: $\int_a^b f(x)dx = F(b)-F(a)$. (Newton, Leibniz $\sim$ 1687.) It says, find the *function* so $F'(x) = f(x)$, and it solves the area problem $\int_a^b f(x)dx$. The FTC connects two seemingly entirely different notions: the derivative of 21A and the integral of 21B. How could you even express this connection between areas and rates of change without the concept of a "function"? Given this, how can we systematically translate the language of calculus and "functions", into the language of "computers", so we can compute with them? The most important way is Power Series.

• The theory of Power Series set out in 21C explains how each differentiable function can be approximated at every order by a *unique* polynomial called its $Taylor$ polynomial. And the higher the order of the polynomial, the better the approximation–and there is an *estimate* for the error between the output of a general function and the output of its Taylor polynomial at every order. Thus the theory of Taylor Series described in Math 21C tells how to translate *functions* into approximations for use in *computations*. Actually, there's an even bigger surprise. Turns out, functions described by their Taylor Series, without approximation, are precisely the functions which extend calculus to imaginary complex numbers. (Incredible!) That's explained in Math 185A.

Department Syllabus/Schedule:

Lecture(s)/Sections/Topics
1/10.1/Sequences
1/10.2/Infinite series
1/10.3/The Integral test
1.5/10.4/Comparison tests
1.5/10.5/The Ratio and Root tests
1/10.6/Alternating series, Absolute/Conditional Convergence
1/10.7/Power series
1/10.8/Taylor and Maclaurin series
1/10.9/Convergence of Taylor series
1/10.10/The binomial series and applications of Taylor series
0.5/12.1/Three-dimensional coordinate systems
0.5/12.2/Vectors
1/12.3/The Dot Product
1/12.4/The Cross Product
1/12.5/Lines and planes in space
1/13.1/Curves in space and their tangents
1/13.2/Integrals of vector functions, projectile motion
1/14.1/Functions of several variables
1/14.2/Limits and continuity in higher dimensions
1/14.3/Partial derivatives
1/14.4/The Chain Rule
1/14.5/Directions derivatives and gradient vectors
1/14.6/Tangent planes and differentials
1.5/14.7/Extreme values and saddle points
1.5/14.8/Lagrange Multipliers