University of International Business and Economics

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International Summer School

MAT 230 Multivariable Calculus (Calculus III)

Term: May 28 – June 28, 2018
Instructor: SEMA SALUR
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Class Hours: Monday through Thursday, 120 minutes each day
Office Hours: TBD
Discussion Session: 2 hours each week

Total Contact Hours: 66 contact hours (45 minutes each)
Credit: 4 units

Course Description:
In this course, the student will gain knowledge of the theory of multivariable calculus, that is, generalizations of the notions of differentiation and integration to the settings of vector-valued functions (curves), real-valued functions of vectors, and vector fields.

Course Goals:
A student who satisfactorily completes this course will:

1. Have facility with the basic theory and techniques of integral and differential vector calculus: e.g., the various types of vector products, notions of arc length and curvature, generalizations of the derivative (partial derivatives, directional directives, etc.); integrals of multivariable functions, change of variables, vector fields, line integrals, divergence, gradient and curl, integrals of vector fields over surfaces, etc.

2. Have precise knowledge of the definitions, theorems, and derivations from the basic theory of multivariable calculus: e.g., the geometric interpretation of the dot product, various formulae for the arc length, the relationship between gradient and directional derivatives, the change of variable formula, and various generalizations of the fundamental theorem of calculus.

3. Have facility with basic calculational skills: e.g., facility with vectors, evaluation of arc length and curvature, ability to determine tangent planes, facility with the Lagrange multiplier method, ability to calculate double and triple integrals, surface integrals, etc.

4. Have a rudimentary ability to explain mathematical theory using rigorous mathematical reasoning.

Required Textbook:
Stewart, James. *Multivariable Calculus*, 6th edition

Grading Policy:
In this course, grading will be based on: Participation 5%; Homework: 15%; Exams: 10%, 20%, and 20%; Final Exam: 30%. **No make-up exams will be given.** Any cheating on exams will result in an automatic zero for that exam.

Grading Scale:
Grades will be curved, with roughly the class mean set as the boundary between a B and a B+, adjusted at the professor's discretion.

Class Rules:
- ✧ Students are expected to attend all classes and be responsible for all material covered in class and otherwise assigned. Any unexcused absence may impact a student's grade. UIBE policy is that a student who has missed more than 1/3 classes of a course will fail the course
- ✧ Students must complete the day's required reading and assignments before class. No late homework will be accepted; unstapled homework will be penalized by 10%. If a student must miss a class due to illness, the assignment should be delivered by an acquaintance by the beginning of lecture. Plagiarism from another student or from a solutions manual will result in fractional or zero credit, respectively.
- ✧ Students should refrain from texting, phoning or engaging in computer activities during class. Any student engaging in such activities during class will be penalized five percentage points on the next exam.

Attendance Policy:
Summer school is **very intense** and to be successful, students need to attend every class. Occasionally, due to illness or other unavoidable circumstance, a student may need to miss a class. UIBE policy requires a medical certificate to be excused. Any unexcused absence may affect the student's grade. Moreover, UIBE policy is that a student who has more than 1/3 of the class in unexcused absences will fail the course.

Course Schedule: (tentative)

Day	Topics	Homework
1	Three-dimensional Coordinates.	13.1: 6, 11, 15, 19, 20, 36.
	Vectors.	13.2: 19, 22, 23, 24, 35, 36ab, 39, 43
2	Dot Product.	13.3: 7, 9, 11, 16, 23, 37, 41, 57, *58 (bonus problem)
	Cross product.	13.4: 14, 20, 28, 33, 37, 45, *46 (bonus)
3	Lines and Planes.	13.5: 10, 13, 14, 24, 31, 43, 50, 69 (see example 8)
	Cylinders and Quadric Surfaces.	13.6: 12, 15, 23, 30, 33, 42, 43
4	Vector Valued Functions and Space Curves; Derivatives and Integrals of Vector Functions.	14.1: 5, 15, 19-24, 25, 27, *45
	Derivatives and Integrals of Vector Functions; Arc Length.	14.2: 5, 12, 13, 19, 24, 34, 38, 39; 14.3: 3, 4, 8, 10, 13
5	Arc Length and Curvature.	14.3: 15, 16, 18, 19

	Quiz	
6	Arc Length and Curvature.	14.3: 1, 23, 25, 27, 29, 40, 53, *54
	Functions of Several Variables.	15.1: 13, 24, 28, 30, 41, 45, 61, 63
7	Limits and Continuity.	15.2: 1, 9, 10, 11, 15 (tricky?), 20
	Partial Derivatives.	15.2: 6, 13 (squeeze), 17, 19, 33, 37, 38, 41
8	Partial Derivatives.	15.3: 6, 9, 10, 17, 24, 28, 43, 57. Bonus: Let f(x) = x if x is rational; 0 if x is irrational. Show that f is continuous at 0, but discontinuous everywhere else.
	Tangent Planes Differentiability and Chain Rule.	15.4: 5, 6, 11, 17, 18, 19, 25, 26, *35, 42
9	Chain Rule.	15.5: 2, 5, 6, 7, 11, 21, 27 (read Equation 6), 45 (used in physics), *55
	Gradients, Directional Derivatives.	15.6: 7, 10, 13, 15, 16, 21, 23, 34
10	Max-Min Problems.	15.6: 27, 32, *37, 39, 42, 47, 50; 15.7: 5, 6, 7, 13, 14, 19, 43, 51
	Exam I	
11	Lagrange Multipliers.	15.8: 5, 6, 7, 8
	Double integrals intro.	15.8: 12, 14, 15, 16, 41,*45, *46
12	Iterated Integrals.	16.2: 1, 7, 8, 16, 17, 18, 24
	Double Integrals	16.3: 2, 5, 6, 9, 11, 14, 17, 20
13	Double Integrals Continued.	16.3: 21, 24, 25, 27, 41, 42, 43, 47, 53
	Double Integrals in Polar Coordinates.	16.4: 5, 6, 7, 11, 12 (tricky?), 16, 22, 26, 30, *36
14	Triple Integrals.	16.6: 3, 7, 9, 11, 14, 21, 22 [can use polar coordinates for 21, 22], 28, 36.
	Triple Integrals in Cylindrical Coordinates.	16.7: 9, 12, 15, 19, 21, 22, *26
15	Triple Integrals in Spherical Coordinates.	16.8: 9, 13, 15, 21, 24 (int. by parts), 26, 28, 39
	Exam II	
16	Change of Variable Formula.	16.9: 1, 2, 3, 6, 7, 9, 10, 11
	Vector Fields.	16.9: 12, 14, 15, 17, 19, 21, 22; 17.1: 6, 7, 21, 23, 29, 34, 35
17	Line Integrals.	17.2: 3, 5, 7, 11, 12, 15; 17.2: 18, 19, 20, 21, 22
	Fundamental Theorem of Calculus for Line Integrals.	17.3: 13, 15, 16, 20, 21, 27, 29, 31
18	Green's Theorem.	17.4: 1, 3 (somewhat of a pain), 5, 7, 8 (switch to polar at some point), 9, *13 (not hard, just a matter of understanding the notation)

	Div, Grad, Curl.	17.5: 1, 5, 6, 7, 13, 15, 19
19	Parametric Surfaces. Surface Integrals.	17.6: 13-15, 17, 21, 23, 24; 17.6: 33, 34, 37, 41, 42, 47; 17.7: 5, 7, 9, 15
	Surface Integrals, continued.	17.7: 19, 21, 22, 23, 25
20	Stokes's Theorem.	17.8: 1, 3, 6, 8, 15, 16
	Final Exam	

General Comments:

- ✧ In order to train your minds in mathematical thinking, much of lecture will consist of the "Socratic Method" of questioning. Even if silently, do try to puzzle out the answers. An analogy: the lecture should be a "mental exercise" class. Knowledge cannot be given: it must be stolen. Engage your mind.
- ✧ Many problems will not be solvable at first (or second) viewing. Be patient: clarify any unknown concepts, try to reduce the problem, brainstorm to unearth possibly relevant concepts, and follow your intuition. It may help to, after a period of hard work, put the problem away. Do not worry if you cannot do every problem: what is important is that you try.
- ✧ If you find yourself getting lost in the material, come to office hours immediately! It is much is easier to lead a student's mind individually rather than in a group.
- ✧ Note that we may not dot every i or cross every t in class: you are responsible for reading the text. In particular, it is to your advantage to read the material before coming to class; in this way the student becomes an active participant rather than a passive recipient.
- ✧ Basic etiquette should be maintained. For example: to give your classmates time to think, please do not blurt out answers unless called upon (or overcome with excitement); please do not walk out of class without prior explanation, etc.
- ✧ Using a cell phone in class is not permitted; students using phones will be penalized 5 percentage points on the next exam.
- ✧ Tests will check your understanding of the lectures as well as cover homework-type problems; it will benefit you to check after each lecture to see if you've understood the line of the arguments. Precise knowledge of the theory is vital!