AMAT 223 - Calculus III

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<tr><td>Course Title</td><td colspan="5">Calculus III</td></tr>
<tr><td>Course Code</td><td colspan="5">AMAT223</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">2nd /2nd</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Dr Marios Charalambides</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td></td></tr>
<tr><td>Course Purpose</td><td colspan="5">The purpose of the course is to introduce students to a more realistic setting, the three dimensional space. Starting with visualization of vectors we introduce students to three dimensional surfaces and to functions of two variables that represent them. After that, we revisit fundamental questions answered in earlier courses for functions of one variable. In detail, the question for a tangent line of a function of one variable is equivalent to the question of a tangent plane of a function of two variables. As a result questions regarding derivatives, maximum and minimum points are addressed in this new setting. In functions of one variable we can compute the area under a curve using integration. In three dimensions we deal with surfaces so it is normal to search for surface area and volume under a surface. These questions are addressed with integration but new techniques are introduced to accommodate the higher complexity of the new topics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">1. Explain the concepts of rectangular coordinates, 3-D vectors, and vector-valued functions, calculate 3-D vectors, the vector (cross) and dot products of two vectors and explain their geometric meaning, and find the equation of a plane containing three points.

2. Recall and employ the standard graphs of straight lines, the circle, the parabola, the ellipse, and the hyperbola, in order to solve problems in space involving general cylinders, quadric, and more general surfaces.

3. Explain the concept of real-valued functions of several variables, employ partial differentiation including implicit and the multivariable chain rule to find the gradient vector and the equation of tangent planes.

4. Find and classify the critical points of functions of several variables, and solve constrained maximum-minimum problems by using the Method of Lagrange Multipliers.</td></tr>
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	5. Evaluate double and triple integrals over general regions, including surface integrals, by changing the order of integration or converting to polar, cylindrical, and spherical coordinates. 6. Explain the notion of vector fields, calculate their divergence and curl, determine conservative vector fields, and state the Fundamental theorem of independence of path for conservative vector fields. 7. Explain the concept of line integrals, and evaluate them by employing several methods, including the Fundamental theorem for conservative vector fields. 8. State Green's, Divergence, and Stoke's theorems, and choose the most appropriate technique, according to the specific problem, to solve the integrals involved. 9. Choose the appropriate technique described in the course to find solutions to basic engineering applications.		
Prerequisites	AMAT122	Corequisites	None
Course Content	• Three Dimensional Space, Vectors: Rectangular coordinates & 3-D vectors, the vector (cross) and dot products of two vectors, lines and planes in space, quadric and more general surfaces. • Vector Valued Functions: Vector valued functions, curves and motion in space. • Functions of several variables and optimization: Functions of several variables and the chain rule, directional derivatives and the gradient vector, tangent planes, maximum and minimum values of functions of several variables, the 2^{nd} derivative test for functions of two variables, Lagrange Multipliers and constrained max-min problems. • Double Integrals: Double integrals over general regions, area and volume by double integration, change of variables in double integrals, double integrals in polar coordinates. • Vector Fields and Line Integrals: The del operator (div, grad, and curl in rectangular coordinates), vector fields, line integrals, the fundamental theorem and independence of path, Green's theorem. • Triple Integrals: Triple integrals, volume by triple integration, change of variables in triple integrals, triple integrals in cylindrical and spherical coordinates. • Surface area and Surface integrals. • Divergence and Stoke's theorems.		
Teaching Methodology	The course is delivered to the students by means of lectures, conducted with use of PowerPoint presentations and the whiteboard. The students are also engaged in the course through questions by the lecturer which are discussed in class. Several examples are solved on the white board, with the participation of students. Students are encouraged to leave their seats and solve examples on the board as well.		

	Students are asked to work on their own during class hours on practice problems, and they are encouraged to ask questions. Many additional exercise sheets and material is available to students through the e-learning platform. Students are encouraged to attend office hours for extra help. Students are encouraged to attend the peer tutoring center for extra help.
Bibliography	(a)Textbooks: • Anton H., Bivens I and Davis S, *Calculus: Early Transcendentals*, 11th edition, Wiley, 2016. (b) References: • Schey H. M., *Div, Grad, Curl, And All That: An Informal Text On Vector Calculus*, W. W. Norton & Co Inc, 2005. • Jerrold E. Marsden, Anthony J. Tromba, *Vector Calculus*, 4th edition, W.H. Freeman & Company, 1996.
Assessment	(a) Methods: Students will be assessed with coursework that involves two in class written tests and a final exam. (b) Criteria: Assessment criteria are available in each test or in the final exam (c) Weights: • Tests 40% • Final Exam 60%
Language	English language