American United of Technology

Faculty of Applied Sciences

MAT 203 – Calculus III
CRN 20128

Semester: Fall 2020

Credit Hours: 3 Credits (Two 1.5-Hour Lectures)

Course Instructor: Dr. Mouhamad Ibrahim

Lecture Timings: TR 10- 11:15 am

Classroom: AG211

Office Hours: To be announced on Moodle

Prerequisite by course: MATH 102: Calculus II

Prerequisite by topic:
Functions and graphs; Trigonometric functions; Logarithmic and exponential functions; Rate of change; Limit and continuity; Tangent lines; Derivatives; Differentiation rules; Indefinite integrals; Definite integrals; Techniques of integration: integration by substitution, integration of trigonometric functions, integration of transcendental functions, integration by parts, integration using partial fractions and trigonometric substitutions; L'Hôpital's rule.

Text book: *Thomas' Calculus,* 12th edition, by G. Thomas as revised by M. Weir, and J. Hass.
References: Textbook will be placed on Moodle in pdf version.

Catalog Description of the course:

MAT203 Calculus III (3 credits) Improper integrals; Sequences; Infinite series; Power series; Taylor and Maclaurin series; Functions of several variables; Partial derivatives; Linearization; The Chain Rule; Directional derivatives and tangent planes; Extreme values; Lagrange multipliers; Double integrals; Triple integral. Prereq.: MAT102

Course Student Learning Outcomes

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Use L'Hospital's rule to evaluate certain indefinite forms.
- Find derivatives and integrals for logarithmic and exponential functions and for the inverse trigonometric functions.
- Demonstrate ability to integrate more complicated functions using standard methods of integration, including integration by parts, trigonometric substitutions, partial fractions, and tables.
- Define the definite integral as a limit of Riemann sums and interpret it as area.
- Use the Midpoint Rule, Simpson's Rule, and the Trapezoidal Rule to find the approximate value of certain definite integrals.
- Use integrals to measure areas and compute volumes.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.

- Apply appropriate tests for convergence/divergence of infinite sequences and series.
- Find intervals of convergence for power series and represent functions with power series.
- Find the Taylor series expansion of a function near a point.
- Demonstrate understanding of coordinate and vector representations in three-dimensional space.
- Perform and apply vector operations, including the dot and cross product of vectors, in the plane and space.
- Graph and find equations of lines, planes, cylinders and quadratic surfaces.
- Find partial derivatives, directional derivatives, and gradients and use them to solve applied problems.
- Use differentiation for vector-valued functions to compute tangent lines.
- Use differentiation for multivariate functions to find extrema and rates of change.
- Set up and evaluate multiple integrals in appropriate coordinate systems such as rectangular, polar, cylindrical and spherical coordinates and apply them to solve problems involving volume, surface area, density, moments and centroids.

Course Outline

Week(s)	Unit contents	Unit objective
1-2	**Review of differentiation, limits, integration, exponentials, and logarithms**	
3-5	***Chapter 8*- Techniques of Integration** 8.1 Integration by parts 8.2 Trigonometric Integrals 8.3 Trigonometric Substitutions 8.4 Integration of Rational Functions by Partial Fractions 8.5 Integral Tables 8.6 Numerical Integration 8.7 Improper Integrals Exercises	The student will learn how to change unfamiliar integrals into integrals we can recognize, solve, or find in a table. We also extend the idea of the definite integral to improper integrals for which the integrand may be unbounded over the interval of integration.
6-8	***Chapter 10*- Infinite Sequences and Series** 10.1 Sequences 10.2 Infinite Series	The student will be able to represent a differentiable function ƒ(x) as an infinite sum of powers of x. The student will also

	10.3 The Integral Test 10.4 Comparison Tests 10.5 The Ratio and Root Tests 10.6 Alternating Series, Absolute and Conditional Convergence 10.7 Power Series 10.8 Taylor and Maclaurin Series 10.9 Convergence of Taylor Series 10.10 The Binomial Series and Applications of Taylor Series Exercises	learn how to represent a differentiable function ƒ(x) as an infinite sum of powers of x. With this method, we can extend our knowledge of how to evaluate, differentiate, and integrate polynomials to a class of functions much more general than polynomials. We also investigate a method of representing a function as an infinite sum of sine and cosine functions, called Fourier series. This method will yield a powerful tool to study functions.
9-10	***Chapter 12-* Vectors and the Geometry of Space** 12.1 Three-Dimensional Coordinate Systems 12.2 Vectors 12.3 The Dot Product 12.4 The Cross Product 12.5 Lines and Planes in Space 12.6 Cylinders and Quadric Surfaces Exercises	To apply calculus in many real-world situations and in higher mathematics, we need a mathematical description of three-dimensional space. In this chapter we introduce three-dimensional coordinate systems and vectors. Building on what we already know about coordinates in the xy-plane, we establish coordinates in space by adding a third axis that measures distance above and below the xy-plane. Vectors are used to study the analytic geometry of space, where they give simple ways to describe lines, planes, surfaces, and curves in space. We use these geometric ideas in the rest of the book to study motion in space and the calculus of functions of several variables, with their many important applications in science, engineering, economics, and higher mathematics.
11-12	***Chapter 14-* Partial Derivatives** 14.1 Functions of Several Variables 14.2 Limits and Continuity in Higher Dimensions 14.3 Partial Derivatives 14.4 The Chain Rule 14.5 Directional Derivatives and Gradient Vectors 14.6 Tangent Planes and Differentials 14.7 Extreme Values and Saddle Points Exercises	In the study of real-world phenomena, a quantity being investigated usually depends on two or more independent variables. Here we need to extend the basic ideas of the calculus of functions of a single variable to functions of several variables. Although the calculus rules remain essentially the same, the calculus is even richer. The derivatives of functions of several variables are more varied and more interesting because of the different ways in which the variables can interact.

		Their integrals lead to a greater variety of applications. The studies of probability, statistics, fluid dynamics, and electricity, to mention only a few, all lead in natural ways to functions of more than one variable. We will visit the functions of several variables, limits and continuity in higher dimensions, partial derivatives, the chain rule, directional derivatives and gradient vectors, tangent planes and differentials, extreme values and saddle points up to section 14.7
13-14	***Chapter 15*- Multiple Integrals** 15.1 Double and Iterated Integrals over Rectangles 15.2 Double Integrals over General Regions 15.3 Area by Double Integration 15.4 Double Integrals in Polar Form 15.5 Triple Integrals in Rectangular Coordinates 15.6 Moments and Centers of Mass 15.7 Triple Integrals in Cylindrical and Spherical Coordinates 15.8 Substitutions in Multiple Integrals Exercises	In this chapter we consider the integral of a function of two variables ƒ(x, y) over a region in the plane and the integral of a function of three variables ƒ(x, y, z) over a region in space. These integrals are called multiple integrals and are defined as the limit of approximating Riemann sums, much like the single-variable integrals presented in Chapter 5 of the book. We can use multiple integrals to calculate quantities that vary over two or three dimensions, such as the total mass or the angular momentum of an object of varying density and the volumes of solids with general curved boundaries.

Grading Policy:

Class Attendance & participation	10 %
Homework assignments	10 %
2 Tests	10 %
Midterm exam	30 %
Final Exam	40 %

Midterm and Final Exam Schedule: To be announced during the semester

Lecture expectations: Class attendance and participation is essential to student success. Come to class prepared: Before attending a lecture, read thoroughly (from your book and class notes on Moodle) the material covered in the previous lecture and solve the related homework problems. During the lecture, we will discuss problems, work in groups sometimes, and analyze concepts. Ask questions, and participate in the discussion!

Policy on Cheating: Cheating is a very serious offense and will not be tolerated. Copying home works, or any other form of illegal help, will be dealt according to university academic conduct policy.

Reading: You are expected to do the reading from the appropriate sections BEFORE coming to the class meeting in which the topic is scheduled.

Exercises: You are expected to work the assigned exercises after the corresponding material is presented in class, and BEFORE the next class meeting (lecture).

Technology:

Calculator – Students will be expected to use either a laptop computer or a basic graphing calculator for homework and classroom exercises. **<u>You may use a calculator for each test, but you will be required to show all work for the tests</u>** and if you rely on a sophisticated graphing calculator for solutions, you will get zero credit. You are here to learn calculus and the calculator may be used only as an aid.
<u>Students will not be permitted to use computers on any unit test or the Final Exam</u>.

Cellphones and other technology – Students will not be permitted to use cellphones or any other technology (including smart watches) on any unit tests or the Final Exam. Cellphones should be silenced and stored away during class.

Contribution of Course to meeting the professional component:

Mathematics and Basic Sciences 100%