ENAS 151

NOTE: This class will be an online course using Zoom. The course material, assignments and exams will be comparable to that given as an "on campus" course.

Professor Mitchell D. Smooke   May 27, 2025
Multivariable Calculus for Engineers   ENAS 151
Time: TWTh 10:00-12:15 PM
Office: Becton 205
Phone: 432-4344

Overview

The course will introduce the engineering and applied science student to multivariable calculus for use in solving problems of physical interest. The course will focus on topics including three-dimensional spaces and vectors, vector-valued functions, partial derivatives, multiple integrals and vector calculus including Green's, Stokes' and the divergence theorems.

Prerequisites

A solid working knowledge of basic concepts from calculus (Math 112, 115) is required.

Requirements

The course grade will be composed of homework (20%), and four midterms (20% each). The homework is designed to expand the material covered in the lectures. Assignments will be posted on the class server each week and will be due in class the following week. The midterms will be given online on Friday of each week starting in week two. The exams will be open book.

Text

The required text is *Calculus (Multivariable)* 10th Edition by Anton, Bivens and Davis.

Miscellaneous

Office hours: After class or by appointment via Zoom.

Teaching Assistants: TBD

I.   Vectors and Three-Dimensional Space

a.   Rectangular Coordinates in 3-space
b.   Cylindrical Surfaces/Spheres
c.   Vectors
d.   Dot and Cross Products
e.   Parametric Equations of Lines
f.   Planes
g.   Quadric Surfaces
h.   Examples: Lone Cypress, Valley of the Kings, Hubble Telescope, Dynamometer

II.   Vector-Valued Functions

a.   Calculus of Vector Valued Functions
b.   Change of Parameter – Arc Length
c.   Tangent, Normal and Binormal Vectors
d.   Curvature
e.   Motion Along a Curve
f.   Examples: Slinky, Adaptive Gridding, Rock 'n' Roller Coaster, Kepler's Laws

III.   Partial Derivatives

a.   Functions of More than one Variable
b.   Limits and Continuity
c.   Partial Derivatives
d.   Differentials
e.   The Chain Rule
f.   Directional Derivatives and Gradients
g.   Tangent Planes and Normal Vectors
h.   Maxima and Minima of Functions of Two Variables
i.   Lagrange Multipliers
j.   Examples: Laplace's Equation, Heat Equation, Wave Equation, Space Shuttle, Skiing, Sidewinder, CD cutout

IV.   Multiple Integrals

a.   Double Integrals
b.   Double Integrals over Nonrectangular Regions
c.   Double Integrals in Polar Coordinates
d.   Surface Area

e.   Triple Integrals
f.   Centroid, Center of Gravity
g.   Triple Integrals in Cylindrical and Spherical Coordinates
h.   Change of Variables in Multiple Integrals, Jacobians
i.   Examples: WGS and the Volumes of the Earth, The Titanic, Icebergs

V.   Topics in Vector Calculus

a.   Line Integrals
b.   Path Independence and Conservative Vector Fields
c.   Green's Theorem
d.   Surface Integrals
e.   Flux
f.   Gauss's (Divergence) Theorem
g.   Stokes' Theorem
h.   Examples: Gravitational Law, Coulomb's Law, Potential Fluid Flow, Circulation