MA1116: Vector Calculus

Prerequisite

- MA1115 *Multi-Variable Calculus*

Required Texts

- *Calculus: Early Transcendentals*, 8th Edition by James Stewart (2015).
  ISBN-10: 1285741552 ISBN-13: 9781285741550.

Assessment

- No calculators, books, crib sheets, or notes are allowed in any testing.

Topics

Hours	Topic	Section	Homework
3-3	Vector Fields	16.1	3, 5, 6, 9, 11–14, 15–18, 23, 26, 29–32, 35
3-6	Line Integrals	16.2	1, 3, 5, 11, 17–19, 33, 41–43, 52
3-9	Fundamental Theorem for Line Integrals	16.3	1, 3, 5, 7, 13, 15, 19, 21–23, 25, 29, 34, 36a
3-12	Green's Theorem	16.4	2, 5, 9, 11, 13, 19, 21
3-15	Curl and Divergence	16.5	3, 5, 8–11, 13, 17, 25, 31, 37, 38
3-18	Parametric Surfaces and Their Areas	16.6	3–6, 13–18, 20, 23, 31, 33, 39, 45, 47
3-21	Surface Integrals	16.7	9, 12, 17, 21, 27, 29, 30, 44, 45, 47
3-24	Stokes' Theorem	16.8	1, 4, 5, 9, 10, 13, 15, 17
3-27	Divergence Theorem	16.9	1, 4, 5, 7, 14, 17, 19, 23, 31, 32
1-28	Del in Cylindrical and Spherical Coordinates[1]		
5-33	Reviews, Exams, Holidays		

Course Objectives

Upon completion of this course, the student should be able to:

- Sketch vector fields in two or three dimensions. Use them to represent particle displacement, gravitational force, fluid velocity, electric and magnetic fields, or the gradient of a scalar field.
- Evaluate the line integral of a scalar or vector field along a space curve. Calculate the mass and center of mass of a wire, or work done by a force field on a particle moving along a space curve.
- Determine whether or not a vector field is conservative. If it is, find the scalar potential function.
- Use the fundamental theorem for line integrals to evaluate the work done by a conservative vector field. Understand the law of conservation of energy and its application to orbital mechanics.
- Integrate both sides of the scalar form of Green's Theorem. Understand the vector forms of Green's theorem. Use line integrals to calculate area.

[1] `https://en.wikipedia.org/wiki/Del_in_cylindrical_and_spherical_coordinates`

- Calculate the curl and divergence of a vector field, and the Laplacian of a scalar field. Give a physical interpretation of the curl and divergence of a velocity field.
- Sketch quadric surfaces and give their equations in implicit, explicit, or parametric form. Find the equations of the tangent planes or unit normal vectors to a surface.
- Use spherical or cylindrical coordinate systems for surfaces with appropriate symmetry.
- Find surface areas and evaluate surface integrals for surfaces given in parametric or explicit form. Calculate the mass and center of mass of a thin shell.
- Evaluate flux integrals. Calculate fluid, electric, or heat flux across a surface.
- Integrate both sides of Stokes' theorem and both sides of the divergence theorem.
- Describe the similarities between the fundamental theorem of calculus, the fundamental theorem for line integrals, Green's theorem, Stokes' theorem, and the divergence theorem.