

**Topics for Exam 2****1. Differentiability: The Chain Rule**

- 1.1 Directional derivatives of scalar fields
- 1.2 The Jacobian matrix of a differentiable function
- 1.3 The derivative of a composition of functions

**2. Differentiable Paths**

- 2.1  $C^1$  curves and parametrizations
- 2.2 Simple  $C^1$  curves.
- 2.3 Piecewise  $C^1$  simple curves
- 2.4 Simple closed curves
- 2.5 Arclength of a curve; arclength parameter

**3. Integrals on Curves**

- 3.1 Re-parametrizations
- 3.2 Path integrals
- 3.3 Line integrals
- 3.4 Flux across a closed curve

**4. Differential forms and the Fundamental Theorem of Calculus**

- 4.1 Differential 1-forms
- 4.2 Differential 0-forms
- 4.3 The differential of a 0-form
- 4.4 Differential 2-forms
- 4.5 Wedge product of 1-forms
- 4.6 Algebra of forms
- 4.7 The differential of a 1-form
- 4.8 Calculus of forms
- 4.9 Integration of forms
- 4.10 The Fundamental Theorem of Calculus
- 4.11 Evaluating differential 2-forms in oriented triangles: Double integrals

**Relevant sections in the text:** Sections 2.5, 2.6, 2.7, 3.6, 3.7, 3.8, 4.4, 5.2, 5.3, 5.4, 5.5, 11.2 and 11.3.

**Relevant chapters in the online class notes:** Chapters 4 and 5.

**Relevant Assignments:** Assignments 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19.

**Important Concepts:**  $C^1$  curves, piecewise  $C^1$  curves, simple curves, simple closed curves, parametrizations, re-parametrizations, arclength, path integral, line integral, flux, differential forms, wedge product of forms, and double integrals.

**Important Skills:** Know how to compute the Jacobian matrix of a differentiable map, know how to apply the Chain Rule, know how to evaluate the arclength of  $C^1$  curves, know how to evaluate path integrals, know how to evaluate line integrals, know how to compute flux across a simple closed curve, know how to evaluate differential 1-forms and differential 2-forms, know how to evaluate double integrals, know how to apply the Fundamental Theorem of Calculus.