

**Topics for Exam 2****1. Differentiability**

- 1.1 Definition of differentiability
- 1.2 The derivative as a linear approximation
- 1.3 Derivatives of vector valued functions
- 1.4 Derivatives of scalar fields: gradient; partial derivatives, directional derivatives.
- 1.5 The Chain Rule
  - i. Directional derivatives of scalar fields.
  - ii. The Jacobian matrix of a differentiable function.
  - iii. The derivative of a composition of functions.
  - iv. Divergence of a vector field.

**2. Integrals on Curves**

- 2.1 Simple  $C^1$  curves and parametrizations; re-parametrizations; piecewise  $C^1$  simple curves; closed curves.
- 2.2 Arclength of a curve; arclength parameter.
- 2.3 Path integrals.
- 2.4 Line integrals.
- 2.5 Flux across a closed curve.
- 2.6 Double integrals.
- 2.7 The Fundamental Theorem of Calculus in two dimensions.

**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 and 5.5.

**Relevant chapters and sections in the online class notes:** Chapter 4, Sections 5.1, 5.3, 5.3 and 5.4.

**Important Concepts:** Differentiability; the derivative map; partial derivatives; the gradient of a scalar field; the divergence of a vector field;  $C^1$  curves; piecewise  $C^1$  curves; simple curves; simple closed curves; parametrizations; re-parametrizations; arclength; path integral; line integral; flux and double integrals.

**Important Skills:** Know how to show whether a function is differentiable or not; know how to compute partial derivatives, gradients and directional derivative of scalar fields; 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 double integrals; know how to apply the Fundamental Theorem of Calculus.