Chapter 10

Parametric curves and their derivatives, arc length (integration) with parametric curves. Equations to remember: dy/dx in terms of dy/dt and dx/dt; using parametric integrals to solve for arc lengths and surface areas.

Polar coordinates and area and length integrals using polar coordinates. Equations to remember: how to change coordinates back to x, y; dy/dx in terms of $dr/d\theta$; symmetries; using polar coordinates to find the area of regions of the plane.

Chapter 12

Vectors, dot product, cross product, and their properties. Equations to remember: how to relate cosine and sine to dot and cross product; orthogonality and dot product; projections.

Parameterized equations of lines using vectors. Equations of planes using normal vectors. Distance formulas.

Equations for quadric surfaces.

Chapter 13

Parameterized curves as vector-valued functions. Differentiating and integrating vector-valued functions.

Chapter 14

Functions of several variables and their relationship to level sets (where does the graph of a function from $\mathbb{R}^2$ to $\mathbb{R}$ live? where do the level sets of a function from $\mathbb{R}^3$ to $\mathbb{R}$ live?). Continuity of functions of several variables (how do you show a function is continuous or discontinuous at a point?).

Partial derivatives as limits and as derivatives of cross-sections. Second partial derivatives.

Tangent planes, differentials (dz), and approximations.

Chain rule and implicit differentiation.

Directional derivatives, the gradient, $\nabla f \cdot u = D_u f$, ∇f as the normal vector to level surfaces (which can thus be used to find tangent planes).

Local minima and maxima, critical points, the second derivative test (note that "local max, local min, saddle" doesn't cover all possible critical points; think about the function $z = \sqrt{1 - x^2}$). Finding absolute maxima and minima on a closed bounded region.