

Test 1: All Unit 1 notes and posted Unit 1 slides

Basic calculus/ Diff. Eq. knowledge

- Solving simple 1st and 2nd order linear DEs like in the HWs; Differentiate and integrate basic functions ($\sin t$, $\cos t$, e^t , t^n , $1/t^n$).

Sec. 1.1-1.3: Vectors

- **1.1-3** Euclidean space; Vector notation; Vectors between two points; Equation of a line; Inner product; Length of a vector; Unit vector; Angle between 2 vectors; Perpendicular; Work; Cross product (and geometrical interpretation); Area of a parallelogram; Volume of a parallelepiped; Equation of a plane.

Sec. 2.1, 2.3-6, 7.3, 3.1, 3.2: Differentiation

- **2.1** Functions from \mathbb{R}^n to \mathbb{R}^m : scalar and vector-valued functions and functions of several variables; Graphing quadric surfaces with elliptical traces, planes, and cylinders (see notes and Ch.2 slides).
- **2.3** Partial derivatives; Gradient vector; Matrix of partial derivatives; Linearization
- **2.4** Curve parametrization; Graphing 2D and 3D curves; Velocity; Speed; Tangent vector; Tangent line.
- **2.5** Sum, product, and quotient rule; Composite functions: $f \circ g$; Chain rule.
- **2.6** Tangent plane to a (level) surface; Normal vector to a (level) surface.
- **3.1** Class C^m functions; Second and higher-order partial derivatives; Mixed derivatives theorem.
- **3.2** Taylor polynomial for a function of 2 variables ($T_1(x, y)$, $T_2(x, y)$, and $T_3(x, y)$).

Sec. 7.3, 4.1, 4.3, 4.4: Parametrized surfaces; Vector-valued functions

- **7.3** Surface parametrization; Tangent vector, normal vector, and tangent plane for parametric surfaces; Regular surface.
- **4.1** Acceleration and Newton's second law; Regular path. Sum, product, dot product, cross product, and chain rule (Use and simple proofs).
- **4.3** Vector plots; Flow lines; Gradient vector field.
- **4.4** Del operator; Divergence, Curl; Scalar curl; Laplace operator; Vector identities (use and proofs).

What not to know (everything we did **not** discuss in class):

- Historical Notes.
- **1.2-3**: Cauchy–Schwartz Inequality and Ex. 5 (p.23-24); Orthogonal Projection and Triangle Inequality (p.25-27); Distance: Point to Plane (p.43-44).
- **2.1, 2.3** Level Sets, Curves, and Surfaces (p.78-85); Limit definition of partial derivatives (p.106); Ex. 4 (p.107); Differentiability and TangentPlane (p.109-112); Some Basic Theorems (p.113-114).
- **2.5-6** Proof of Theorems 10 and 11 (p.125-126, p.129), Proof of Eq. (2) on p.127-128; Directional Derivative and Direction of Fastest Increase (p.136-138); The Gradient Vector Field (p.140-141).
- **3.1-2** Example 6 (p.156); Proof of Theorem 3 and Remainder term of Taylor formula (p.161-162).
- **4.1-2** Circular orbits and Supplement to Sec. 4.1 (p.220-226); Example 5 and 6 (p.238-239); Conservation of Energy and Escaping the Earth's Gravitational Field and Escape Velocity (p.240-241).
- **4.4** Interpretation of Divergence (p.246-248), Interpretation of curl (p.250-251).