

## List of topics for Exam #1

**Topics:** The list of topics for Exam #1 includes everything from the beginning of the course up to section 11.9 (included). In other words, it is all the material covered in class corresponding to Chapter 11.

### Chapter 11: Vectors and Vector-Valued Functions

- > **11.1 Vectors in the Plane** Geometric and analytic definitions of vectors, parallel vectors, operations on vectors and properties, vectors and points, unit vectors, circles in the plane.
- > **11.2 Vectors in 3D space** The  $xyz$ -coordinate system, coordinate planes, the right-hand rule, vector operations, unit vectors and the unit sphere, spheres in 3D space.
- > **11.3 Dot Products** Dot products of vectors in 2D and 3D, geometric and analytic definitions, properties, orthogonal vectors, dot products and angles.
- > **Determinants** Matrices, 2x2 and 3x3 determinants.
- > **11.4 Cross Products** Cross products of vectors in 3D space, geometric and analytic definitions, properties.
- > **Generalities on sets and functions** Sets, operations on sets and properties, functions between sets, terminology and notations.
- > **11.5 Lines and Curves in Space** Parametrized curves in 2D and 3D, parametrized straight lines, straight line segments, circles, helix, properties.
- > **11.6 Calculus of Vector-Valued Functions** Differentiation, notation and properties, geometric interpretation, derivative rules, higher order derivatives, antiderivatives, indefinite integrals and definite integrals.
- > **11.7 Motions in space** Terminology, velocity, speed, acceleration, unit tangent vector, uniform straight-line motion, circular motion, path on a plane, path on a sphere, initial conditions and integrating motion, Newton's second law, motion in a gravitational field.
- > **11.8 Lengths of curves** Arclength, reparametrization of a curve, properties, parametrization by arclength.
- > **11.9 Curvature and normal vectors** Principal unit normal vector, unit binormal vector, Frenet-Serret frame, osculating plane, osculating circle, radius of curvature and curvature.

### **Review material:**

- > **Lecture notes** and supporting **textbook**.
- > **Homework exercises:** refer to the online course schedule for the homework assignments corresponding to the topics in the list of topics.
- > **Quizzes:** Quizzes 1, 2, 3, 4. Refer to the course schedule for the past quizzes and their solutions. Make sure you read all the solutions carefully.
- > You do not need to use any other material to prepare for the exam.

### **General advice**

- Your lecture notes from class are your primary source of information, not the textbook, even though it is a useful support. You are expected to know all the material in your lecture notes, and no other. Review your lecture notes regularly and actively.
- Remember that all past quizzes, exams, solutions sheets, and homework assignments are available on the course web page. Make sure you review them with care.
- It is important that you work hard on your homework problems: do as many exercises as possible, and more importantly do them as seriously as possible. Finding the correct answer is not sufficient: you need to be able to write the proper justifications.
- I am happy to answer your questions, as long as: 1. They are math questions, and 2. You have made a genuine effort to think about your question before reaching out to me.
- The best way to prepare for the exams is to work regularly: try to follow the lectures actively in class, work on your homework assignments regularly, etc.
- Do not expect the exam to just be a straightforward application of the material you reviewed. It will require you to be capable of original thinking.
- Calculators will not be allowed, nor any other resources.