Notes about the final exam:

- Final exam is a regular written test and constitutes 40% of your overall grade.
- It is an open-notes exam. You are allowed to bring one sheet of notes (must be one piece of paper, letter-sized, double-sided printing/writing is fine). You cannot share the sheet during the exam.
- The format of the exam questions should include multiple-choice, matching, short question-and-answers, which are mainly drawn from the lecture notes. There will also be questions similar to your homework assignments.
- In your preparation, please pay attention to understanding a concept and its applications rather than rote memorization.
- The following are topics and concepts important to this class. But please note that while this list should cover most of the topics from which questions are drawn, it’s not guaranteed that this is an exhaustive list.

Lec-1 Introduction

What is a robot? What are the specific challenges for mobile robots? What are the relationships between perception, localization, mapping, path planning and navigation?

Some examples of industrial and research robots (shown in the slides).

Classical control vs behavior based control vs hybrid control

Lec-2 Locomotion and Kinematics

How is locomotion related to kinematics?

Important Issues in locomotion. (e.g., stability considerations for legged and wheeled systems)

Degrees of Freedom for legs and wheels. Comparisons of legged vs wheeled robots.

General considerations about what kind of wheels to choose from (there are 4 choices). What’s good and bad about differential drive?

What are forward and inverse kinematics? Inertial frame vs robot frame and their conversion.

How do kinematic constraints determine a robot’s mobility? Zero motion lines. Degree of mobility, steerability and maneuverability. Holonomic systems (DDOF=DOF).
Lec-3 Perception

Sensor classifications. Proprioceptive vs exteroceptive, passive vs active. Sensor characteristics (there are a bunch of them).

Examples of common sensors, and generally how they work. e.g., how does computer vision work in principle?

Lec-4 Localization

Why odometry can’t be relied upon for localization? What is sensor noise? What is sensor aliasing?

Different types of localization. Why probability theory is used in the localization problem?

Basic probability principles such as Bayes’ rule.

What is a belief? What factors affect it? What is the Markov assumption? How is it used in the belief expression?

What are the motion and sensor models, how do they recursively improve the belief?

General characteristics of different localization approaches: Kalman filter, Markov localization and Particle filters. How do they stack up against solving different types of localization?

Lec-5 Maps and Mapping

Types of maps and their main characteristics.

When is a topological map the most suitable and when is an occupancy grid map the better choice?

How do the features a map contains affect the way a map is used in localization?

What is SLAM? Why the need? How does it work in general (you don’t need to go into details)?

Lec-6 Navigation

Differences between global navigation and local navigation.

Key approaches for both global navigation and local navigation (limited to what’s covered in lecture notes).

Basics of common search techniques, breadth first, depth first, wavefront, A*.