NOTE: The cover page included below must be completed, signed, and stapled to the front of your homework. Homework that does not include a completed cover page will receive zero credit.

Reading: Chapter 5, Sections 1-4 of the textbook.

Part I: Configurations Space

A: In Chapter 5, problems 1-6 deal with defining configuration spaces for various robots. Answer each of these questions. Your answer should be expressed using Cartesian product notation, in terms of $\mathbb{R}$ (the real line), $S$ (the unit circle or sphere), $SO(n)$ (the special orthogonal group of order $n$), $SE(n)$ (the special Euclidean group of order $n$). For example, a robot with one translational and one rotational degree of freedom has the configuration space $Q = \mathbb{R}^1 \times S^1$.

Part II: Artificial Potential Fields

A: Computing workspace potentials requires computing distances between control points on the robot and obstacles in the workspace. Problems 8-10 develop the equations necessary to do this. Solve these problems.

B: Solve problem 11. This problem requires only basis calculus.

C: Solve problem 12. Note that this problem requires computation of appropriate Jacobian matrices.

Part III: Sampling-Based Planners

A: Sampling-based planners require the ability to generate sample configurations. Answer problem 15, which addresses this problem.

B: Briefly, compare sampling-based planning methods to artificial potential fields methods. For example, what are the relative strengths and weaknesses of the two methods? In what ways are the two methods similar? This question is meant primarily to provoke you to think about the underlying difficulties of the path planning problem. A comprehensive answer is beyond the scope of this course, but, depending on your background, you should be able to address certain aspects of this comparison in a thoughtful way.
NAME: (printed) ________________________________________________________________

If you have collaborated with any other person while doing this homework, describe this collaboration in the space below. You must include the names of your collaborators, and a description of your interaction while working on the homework problems.

If you have used any sources other than your textbook and lecture notes while doing this homework, describe these in the space below.

Other than as described above, I have not used any additional material (e.g., old homework solutions, example problems from the internet) in the completion of this assignment.

NAME: (signature) ________________________________________________________________