Student Name: _____ Student ID # _____

OU Academic Integrity Pledge

On my honor I affirm that I have neither given nor received inappropriate aid in the completion of this exercise.

Signature: _____ Date: _____

Notes Regarding this Examination

Open Book(s) You may consult any printed textbooks in your immediate possession during the course of this examination.

Open Notes You may consult any printed notes in your immediate possession during the course of this examination.

No Electronic Devices Permitted You may not use any electronic devices during the course of this examination, including but not limited to calculators, computers, and cellular phones. All electronic devices in the student's possession must be turned off and placed out of sight (for example, in the student's own pocket or backpack) for the duration of the examination.

Violations Copying another's work, or possession of electronic computing or communication devices in the testing area, is cheating and grounds for penalties in accordance with school policies.

Throughout this exam, consider the following robot mission and environment description:

The robot is to clean and organize the practice bays in the Rawl Engineering Practice Facility (REPF). This includes vacuuming the floor and putting away tools, parts, materials, and supplies that are not in use. The robot can access a floor plan of the practice bays that includes the locations of "permanent" elements such as walls and doors and the "normal" locations of movable elements such as stools, work benches, etc. (Note that while these items are all movable by people in the buildings, some of them, such as work benches, are too heavy for the robot to move, while others, such as stools, can be moved by the robot.) All of these elements are individually included in the floor plan, so it is possible to distinguish between elements of different kinds on the floor plan.

People may be present in the practice bays while the robot is operating. People will not actively attempt to impede the progress of the robot but neither will they actively attempt to assist the robot (e.g., by moving out of its way), unless asked. Effectively, the people can be considered to be moving obstacles which the robot must avoid unless it attempts to enlist their assistance. If assistance is requested by the robot, people may be assumed to help in small ways; for instance, they could move a bit to one side or another, open a nearby door, press a nearby button, or point to provide directions towards a destination (if known). However, a person will not go to great lengths to assist—for example, a person might put away the tools they were planning to put away anyway but will not go around the room doing the robot's job for it just because the robot asks.

Question 1: Mission Decomposition (10 points)

List and *describe* a set of at least five key tasks that the robot could carry out to successfully complete this mission.

Question 2: Deliberation and Reaction (10 points)

For each task that you listed in Question 1, *explain* whether that task is a deliberative or reactive task (or both or neither).

Question 3: Deliberation and Reaction (10 points)

A. For each of the elements in the environment description, *explain* what types of difficulties, if any, it causes for a deliberative approach.

B. For each of the elements in the environment description, *explain* what types of difficulties, if any, it causes for a reactive approach.

Question 4: Robot Control Paradigms (15 points)

Explain whether you think the deliberative, reactive, or hybrid deliberative/reactive robot control paradigm is more suited to this mission. (That is, make a cogent argument in favor of using one of these paradigms rather than the other two for this mission and defend your choices with reference to the overall mission and the paradigms' complementary strengths and weaknesses.)

Question 5: Robot Sensing (15 points)

Describe a sensor suite that you believe would be well suited to this mission. *Explain* why you believe it to be well suited to this mission. (That is, make a cogent argument in favor of using these sensors in conjunction with one another for this mission and defend your choices with reference to the overall mission and the sensors' complementary strengths and weaknesses.)

Question 6: Robot Sensing (15 points)

For each task you listed, *explain* how one or more of the sensors you selected would be used in carrying out the task.

Question 7: Localization, Mapping, Path Planning, and Navigation (15 points)

Explain whether you think a topological, metric, or hybrid topological/metric approach to localization, mapping, path planning, and navigation is more suited to this mission. (That is, make a cogent argument in favor of using one of these approaches rather than the other two for this mission and defend your choices with reference to the overall mission and the approaches' complementary strengths and weaknesses.)

Question 8: Metric Mapping (10 points)

A. *Explain* one advantage of uniform grids over quadtrees as the map representation for this mission.

B. *Explain* one advantage of quadtrees over uniform grids as the map representation for this mission.