EE 200 | **Problem Set 3 Cover Sheet** | **Spring 2014**

Last Name (Print): ____________________

First Name (Print): ____________________

ID number (Last 4 digits): __________

Section: ___

Submission deadlines:

- Turn in the written solutions for problems 9 through 12 by 4:00 pm Tuesday February 4 in the homework slot outside 121 EE East.

Problem	Weight	Score
9	25	
10	35	
11	15	
12	25	
Total	100	

Problem 9: (25 points)

During the week of January 20 all students except those in section 5 will complete the safety orientation program at the learning factory. Laboratory sections will be temporarily subdivided into two groups of twelve students. During the first laboratory session of the week, one group will attend an orientation meeting at the Learning Factory that lasts about one hour, while the other group will complete exercises in 302 EE West.

1. Complete the following steps prior to Monday evening January 20. *If you do not successful pass the online quiz, you will not be allowed to attend the orientation meeting held at the Learning Factory.*
   - Navigate to the Learning Factory web page at http://www.lf.psu.edu and read the *Welcome* page.
   - Select the tab *Facilities* on the *Welcome* page, and note the hours of operation and the location of the Learning Factory.
   - On the left hand side of the *Facilities* page, select the *Lab Safety* tab to navigate to the *Safety Policy* page at http://www.lf.psu.edu/Facilities/Safety.html. Carefully study the safety policy before taking the online safety quiz.
   - On the left hand side of the *Facilities* page, select the *LF Training* tab and read the page to learn about the safety and orientation programs. You will attend the *Safety/Power Tools* orientation during the week of January 20.
   - At the bottom of the *Laboratory Factory Safety Training* page, www.lf.psu.edu/Facilities/Training.html, follow the link to the *SAFETY TRAINING QUIZ.*
   - If you successfully pass the online safety exam, notification will be sent to the Learning Factory and you will be allowed to attend the *Safety/Power Tools* orientation during the week of January 20.
2. After completing the *Safety/Power Tools* orientation at the Learning Factory, you will receive a certification card that provides you access to the Learning Factory. To receive credit for Problem 9, you must include a photocopy of your certification card with your solutions to Problem Set 3. If you are already certified to use the Learning Factory facilities, then you will receive full credit for problem 9 by including a photocopy of your certification card with your solutions.

Problem 10: (35 points)

Robots are not just for industry and Walt Disney World. The vacuum-cleaning robot Roomba and floor-washing robot Scooba demonstrate the expanding role of robots in society. This semester you will realize a finite state machine that autonomously guides a robot through a maze using a finite state machine realized with four different technologies, discrete-logic using NAND gates and D-type flip-flops, a complex programmable logic device programmed using hardware descriptive language, an embedded microcontroller programmed using the C language, and a personal computer using the myDAQ and LabVIEW programming environment. This project models the IEEE Micromouse Contest, first announced in the May 1997 issue of Spectrum and annually held at multiple locations around the world. In this contest the contestant designs and builds an autonomous robotic mouse that negotiates a maze of standard dimensions with the objective of completing the maze in the shortest time. The EE 200 project involves a much simpler version of the micromouse contest.

Figure 1 shows the EE 200 mouse which has three sensors, two motorized wheels, and a caster. The sensors provide information about the mouse's environment. They sense an object hitting the right front, left front, or back, of the mouse. The sensors generate CMOS logic levels on three output lines, S_L, S_R, and S_B, corresponding to the front left, front right, and back sensor respectively. A logic high indicates the sensor has impacted an obstacle. Two CMOS compatible input lines, M_L, and M_R, control the motors driving the left and right wheels of the mouse respectively. A low-logic level drives the motor in reverse while high-level logic drives the motor in forward. By setting the inputs signals as shown in Table 1, the mouse can move in the four directions indicated. By observing the sensor and controlling the motors, your finite state machine must maneuver the mouse so that it avoids the obstacles that it hits. In future problem sets where you realize the finite state machine, the mouse will connect to your finite state machine using a 16-pin dual in-line package (DIP) illustrated in Figure 1. You must leave room on your protoboard for this 16-pin DIP plug.

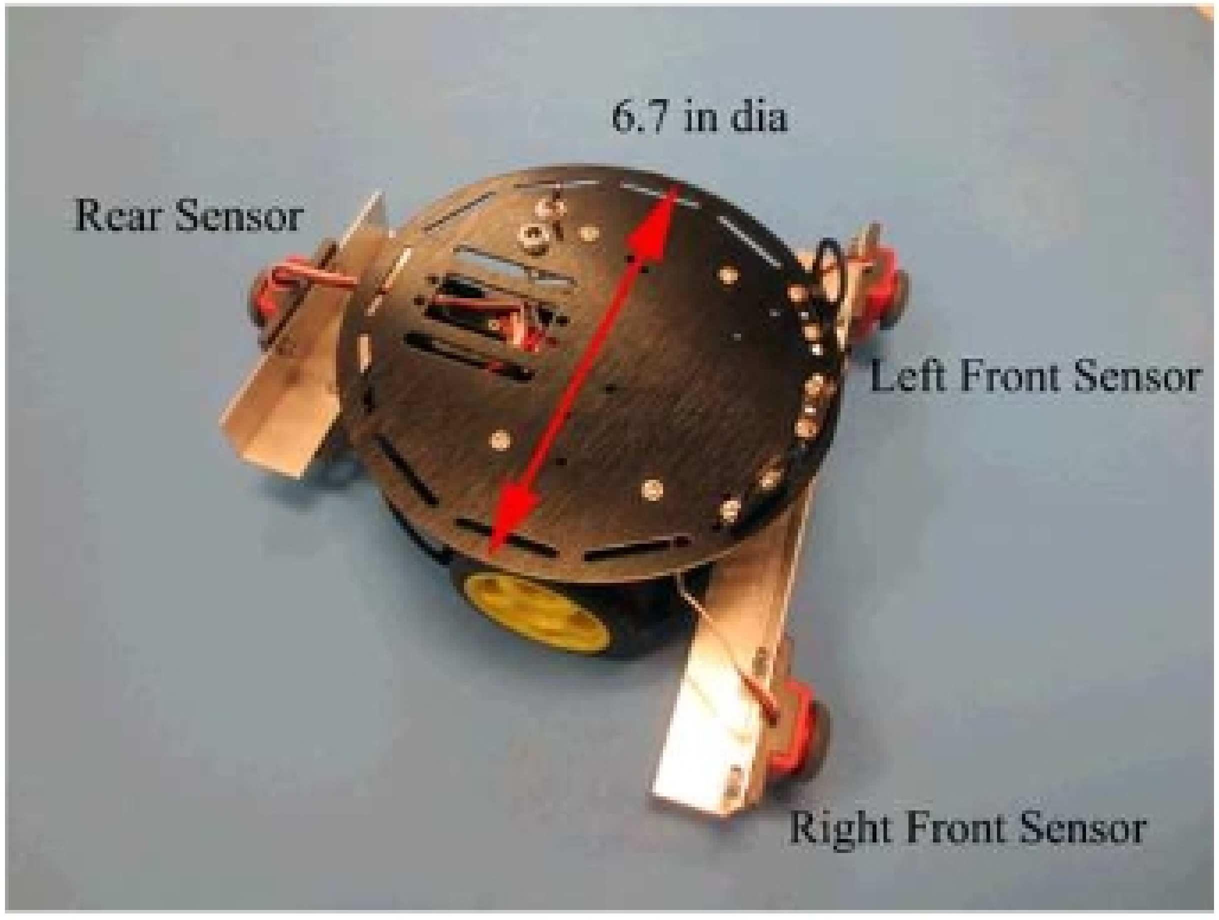

Figure 1: EE 200 mouse.

$\mathbf{M_L}$	$\mathbf{M_R}$	**Mouse Direction**
0	0	backward
0	1	rotate left
1	0	rotate right
1	1	forward

Table 1: Inputs signals M_L and M_R control movement of the mouse.

Pin	**Function**	**Symbol**
1	left sensor signal input	S_L
2	right sensor signal input	S_R
3	back sensor signal input	S_B
4,5,6	ground	DGND
7	left motor output	M_L
8	right motor output	M_R

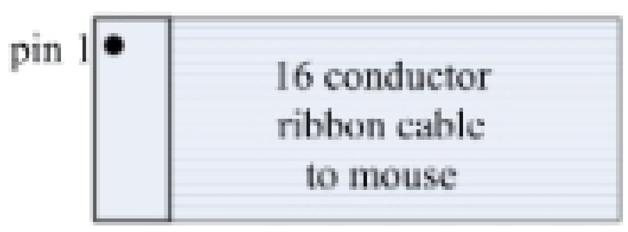

Figure 2: Umbilical cord connector.