**Complex Engineering Problem**

**Line Following Robot**

Course Code and Title: EE-273L: Microprocessor Systems

Semester: Fall 2021 (5th Semester)

Instructor: Miss. Shehzeen Malik

Total Marks: 30 (in Lab)

Deadline: Last week of Semester

**CLOs and PLOs for Complex Engineering Problem**

Please state CLOs and PLOs addressed in the complex engineering problem along with domain and level. These are the CLOs from the theory/lab course which are already defined.

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| **CLOs** |  | **Description** | **Domains & Levels** | **PLOs,**  **Levels** |
| CLO3 | Lab | Design and implement a project to master programming skills. | Psychomotor, 5 | PLO11  High |

**Problem Statement**

The purpose of this Complex Engineering problem is to analyze, specify, design, implement, document, and demonstrate a complete embedded system. Line Following is one of the most important aspects of robotics. A Line Following Robot is an autonomous robot which is able to follow a black line that is drawn on the surface consisting of a contrasting color. It is designed to move automatically and follow the line. The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on the track. The array of **five** sensors makes its movement precise and flexible. The robot is driven by DC motors to control the movement of the wheels. The Microcontroller TIVA Board (Cortex M-4 TM4C1233H6PM) interface will be used to perform and implement algorithms to control the speed of the motors, steering the robot to travel along the line smoothly.

## Grading Policy

The project consists of 3 phases which are discussed below.

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| --- | --- | --- |
| No | Phase | Due Date |
| I | Hardware Demonstration | 11th week of semester |
| II | Open loop testing and input array sensing demonstration | 13th week of semester |
| III | Final competition | Last week of Semester |

## Phase I

The deliverables include:

1. A brief report including a cover page (listing names and roll numbers of all of the members in the team with their respective sections), list of equipment used, details of the equipment, budget of project, complete block diagram based on your own understanding (including exact name of components and their power ratings)
2. An assembled hardware includes the following things
   1. Car body fitting (including connections of motors, wheels, and motor drivers)
   2. Connection of batteries
   3. A complete working PCB/Vero board including opto-couplers (for protection of microcontroller) and regulators to provide fixed 12V to motors and fixed 5V to microcontroller.
   4. Positioning of array of 5 sensor for line tracking.
3. Tasks performed by each group member. (Be fair in this evaluation as you have made groups yourselves, so we trust you completely in this aspect)

## Phase II

1. Cover Page
2. Demonstrate the data of the implemented sensor module connected with microcontroller. The data must be presented on Keil µVision watch window.
3. Complete open loop testing of the hardware body. Open loop speed testing of the hardware using PWM signals generated through microcontroller.
4. Tasks performed by each group member. (Be fair in this evaluation as you have made groups yourselves, so we trust you completely in this aspect)

## Phase III

There will be a departmental level competition of line follower robots in the last week of the semester along with viva. All groups will compete against each-other. Grading will be done based on the working of the project (its speed, time, vibration, code optimization, and its response).

Deliverables for Phase 3 are:

1. A complete working project and its comprehensive report (template will be shared soon)

The project will consist of three phases (deliverables) including the final demonstration. Phase I and Phase II of the project are each worth 25% credit and phase III is worth 50% credit of the marks assigned to the final project. Bonus marks will be awarded to those groups who will do some additional things which can be:

1. Closed loop feedback speed control of motor using PID controller
2. Show the speed of the car on seven-segment display on top of car
3. Show the distance covered by the car on seven-segment display on top of the car