**QUESTION 1**

**Q1)** Wheel specificatins(radius,friction coefficient)Center of gravity,,Mass distribution,Moment of Intertia,Torque and Power, Surface conditions.

**Q2)** Core concept is maintain real time stability and real time feedback and control mechanism

**Q3)** We can add autonomous navigation in the robot

**Proof of Concept:**

**Components Addition:**

* + **LIDAR Sensor**: For environment mapping
  + **Camera’s :** For real time imaging
  + **IMU :** For motion tracking and stability

**Process:**

LIDAR and camera’s we will get surroundings view and with help of Simultaneous Localization and Mapping algorithm we will do mapping. We will also use CV to train the robot to recognize obstacles, humans and traffic signals. Use A\* algorithim to map best suitable route.

**Q4 Project Overview:**

**Assumptions:**

* The robot operates in an environment with well-defined roads and sidewalks, which are accurately mapped and updated in the robot's navigation system.
* The robot will encounter standard traffic conditions, such as traffic lights, stop signs, and crosswalks that are compliant with local regulations.
* Minimal human interference with the robot during its operations.

**Components:**

* + **Base:** Four-wheeled platform with independent motor control.
  + **Parcel Compartment:** Secure storage with automated locking mechanism.
  + **LIDAR:** For 360-degree obstacle detection and avoidance.
  + **GPS:** For route planning.
  + **Cameras:** For visual processing
  + **Microcontroller/Embedded System:** Processing inputs from sensors and managing motor outputs.
  + **Battery Pack:** Provide power for extended operations.

**Software and Navigation:**

1. **Path Planning:**
   * **Algorithm:** Utilize the A\* algorithm for pathfinding which considers the fastest and safest route.
   * **Rerouting:** In case of blocked paths or unexpected obstacles
2. **Obstacle Avoidance:**
   * **Real-Time Processing:** Use sensor fusion from LIDAR and cameras to detect and navigate around obstacles.
   * **Safety Protocols:** Implement emergency stop mechanisms and hazard lights.
3. **User Interface:**
   * **Status Updates:** Provide real time tracking and status updates to consumers via a mobile app.

**Code:**

#include <Servo.h>

#include <Wire.h>

#include <Adafruit\_GPS.h>

Servo steeringServo; int motorSpeedPin = 5;

int motorDirectionPin = 4;

Adafruit\_GPS GPS(&Serial1);

void setup() {

steeringServo.attach(10);

pinMode(motorSpeedPin, OUTPUT);

pinMode(motorDirectionPin, OUTPUT);

GPS.begin(9600);

}

void loop() {

}

**Documentation :**

* **Calculations:** Include power consumption estimates, payload capacity analysis, and expected operational time per charge.
* **Testing:** Test in urban real like settings.