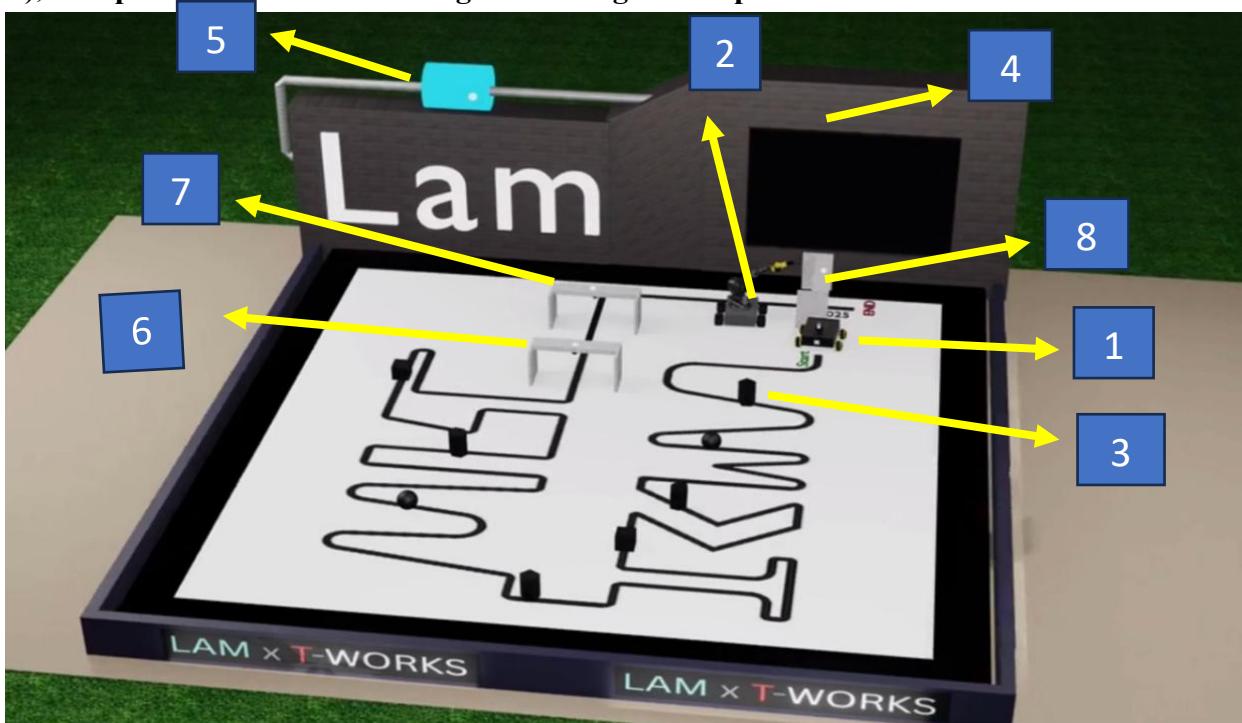


# **Lam Research Challenge 2025**

**ROUND - 2:**  
**HARDWARE HUSTLE**

## PROBLEM STATEMENT:

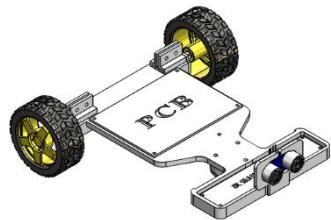
Teams will be provided with a **predefined arena schematic** and a **gameplay challenge**. A **robot kit** will also be supplied. The teams are required to **construct the physical arena** and **build the robots** (**SARM** and **ALFR**), then **participate in the challenge according to the specified rules**.



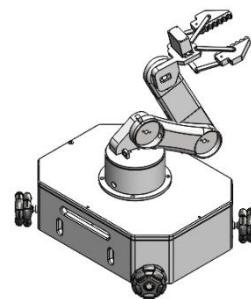
## Hardware Hustle: Lam Research Challenge 2025:

The Gen Z Tech Sprint, *where young minds fire innovation*

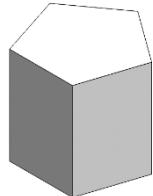
## ROBOTIC SIMULATION ESSENTIALS:



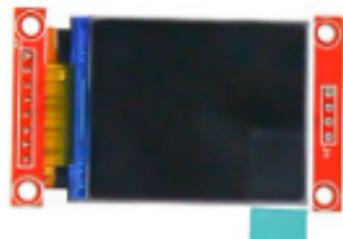
1. Advanced Line Follower



2. Single Arm Robot



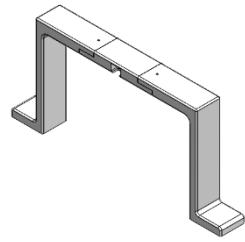
3. Obstacle



4. LCD Display

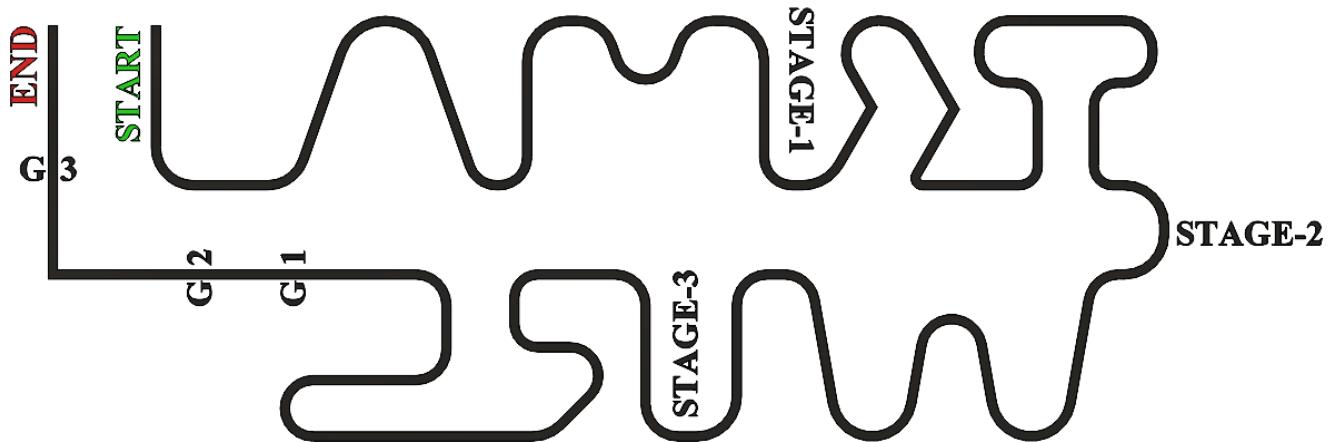


5.Peristaltic Pump

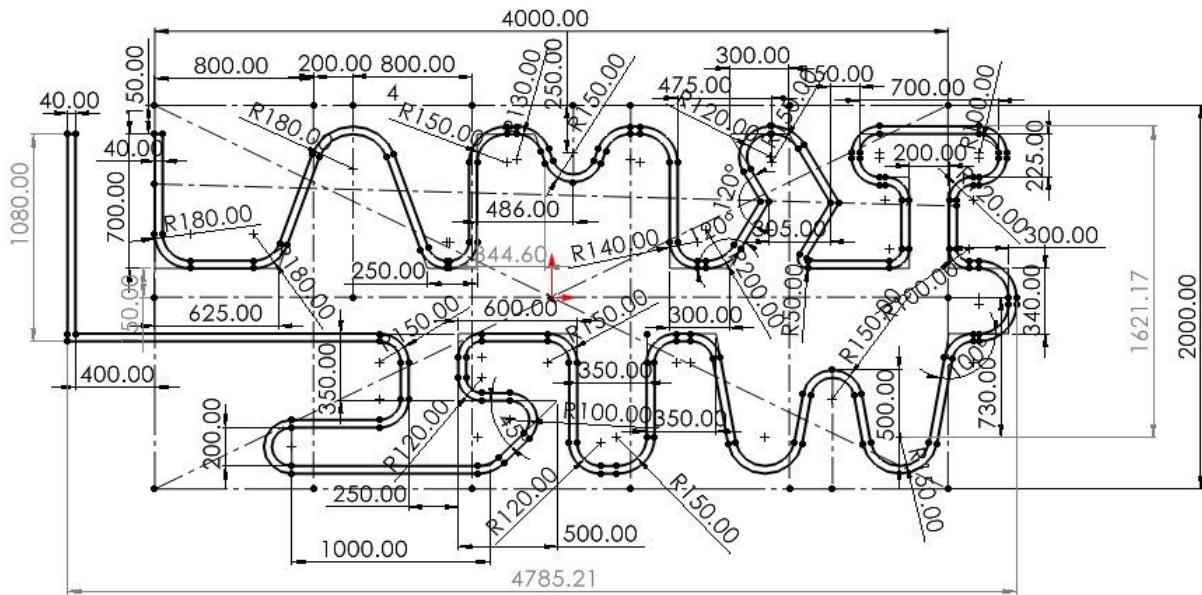


6,7,8.Gate 1,2,3

**ARENA:**

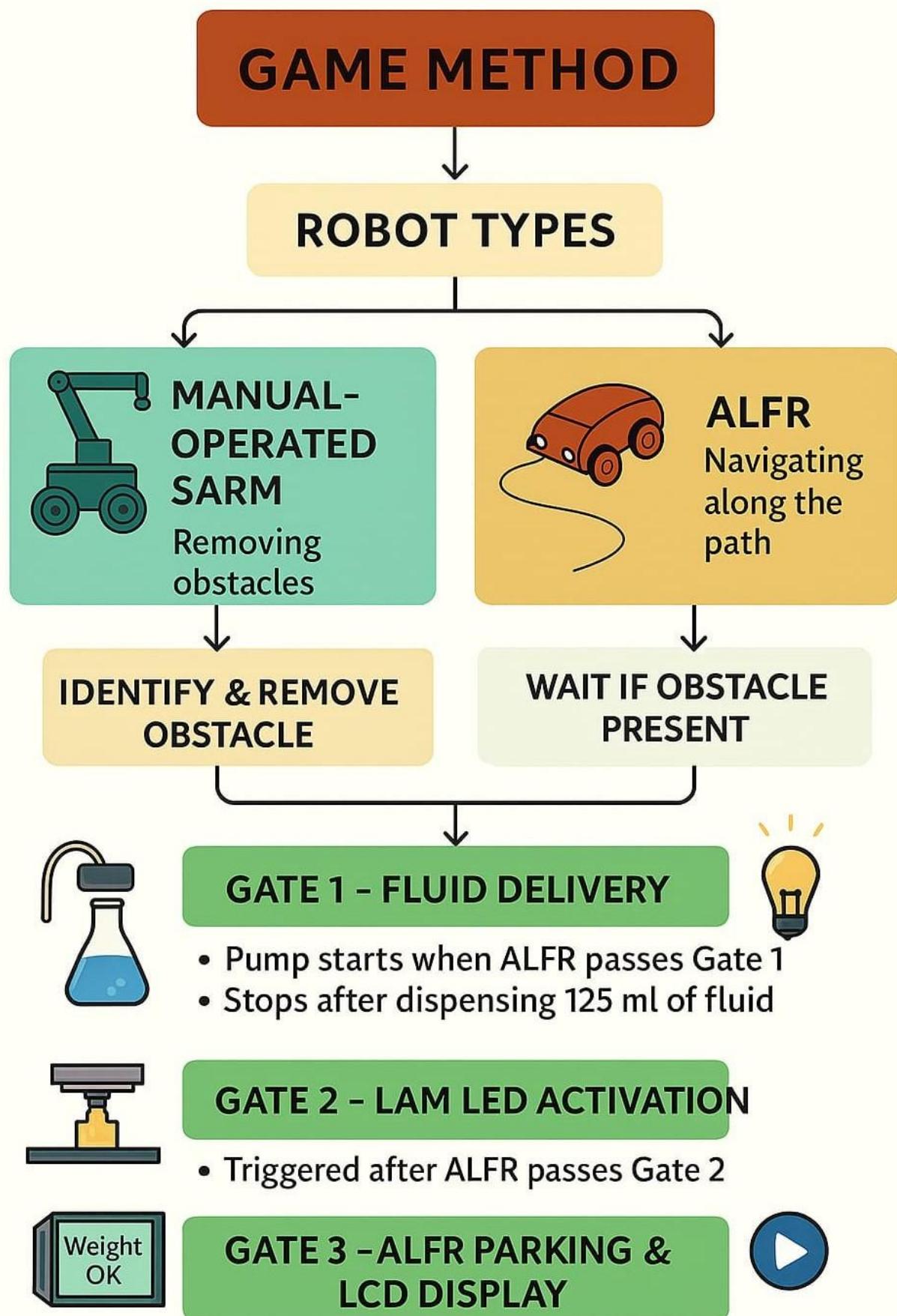


**Arena for the Advanced Line Follower Robot**



**Dimensions of the Arena**

# GAME METHODOLOGY:



## **1. Robot Types**

Each team must design, build, and operate two robots that work in coordination to complete the challenge in COPILA/GAZEBO With ROS/ROS1/ROS2:

- Manual-Operated SARM (Single Arm Robot on Meccanum/Omni Wheels Platform):
  - This robot is manually controlled.
  - Equipped with a robotic arm mounted on a mobile base with Meccanum/Omni wheels for omnidirectional movement.
  - Primary responsibility: identify, pick up, and remove obstacles from the arena path.
- ALFR (Autonomous Line Follower Robot):
  - Fully autonomous robot that follows a predefined line path.
  - Primary responsibility: navigate the arena, wait at blocked junctions, and continue only once the SARM clears the obstacles.

## **2. Obstacle Configuration**

- Multiple obstacles of different sizes are strategically placed at designated points across the arena.
- The placement ensures varying levels of difficulty for clearance and navigation.

## **3. Obstacle Interaction Logic**

- The SRM is responsible for:
  - Manually detecting obstacles along the line path.
  - Picking them up and relocating them away from the line path so they do not interfere with the ALFR.
- The ALFR must:
  - Stop and wait at any junction where obstacles are present.
  - Resume navigation only after the SRM clears the path.

## **4. Line-Following Objective**

- The ALFR must follow the defined line path autonomously.
- On successful navigation, the robot must reach a checkpoint line.
- Upon arrival, an LED array spelling “Lam” will illuminate.

## **5. Switch-Controlled Fluid Delivery Sequence**

The arena includes three sequential switch-activated stations that integrate robotics with fluid delivery:

- **Gate 1 – Fluid Delivery (G1):**
  - Once the ALFR crosses Gate 1, a peristaltic pump needs to be activated automatically.
  - The pump dispenses 125 ml of liquid into a designated container.
  - Once the exact 125 ml is dispensed, the pump should stop.

- **Gate 2 – LED Activation (G2):**
  - As the ALFR passes Gate 2, the **LAM-shaped LED** should glow.
- **ALFR Parking and Load Cell Activation – Final Stage:**
  - The ALFR parks at the final container station.
  - An L-shaped light should activate again.
  - The load cell measures the liquid weight and bot weight for accuracy.

## 6. LCD Display Integration

Upon **successful fluid dispensing** and **ALFR parking** and the weight measurement:

- If the **measured weight matches the required weight**:
  - The **LCD display** will show one of the following:
    - Team Name
    - Video Clip – Team Journey
    - Team Photo
    - Success Message (e.g., “*Simulation Completed!*”) or any unique identifier.
- If the **measured weight does not match**:
  - The **LCD display** will show:
    - Error message (e.g., “*Weight Mismatch – Retry*”)

- Gate 1 = Pump ON → Dispense 125 ml → Pump OFF
- Gate 2 = LAM LED ON
- Gate 3 = Load cell check → Trigger LCD Display if correct

## 7. Time Limit

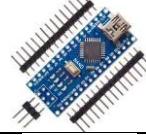
- Game must be completed within 10 minutes.
- For every minute saved, +5 marks will be awarded.

## 8. Google Drive:

[https://drive.google.com/drive/folders/1MbH\\_cHwHw33-X2at1WEAzkLL6CUX0KGN?usp=sharing](https://drive.google.com/drive/folders/1MbH_cHwHw33-X2at1WEAzkLL6CUX0KGN?usp=sharing)

- a) Game Video
- b) Game Rule Book
- c) Arena – SolidWorks 3D Solid Model, png file, pdf file
- d) SARM – Solid works 3D model for Single Arm Robot – Tentative Design
- e) Omni wheeled Platform for Robotic Arm – SolidWorks 3D models (Parts, assembly, zip files)
- f) ALFR – Advanced Line Follower Robot – Solid works 3D models (Parts, assembly, zip files)
- g) Obstacles - Solid works 3D models (Part file)
- h) Gates - Solid works 3D models (Parts, assembly, zip files)

A ROBOT KIT will be sent to the teams. The ROBOT KIT Contains the following

S.No.	Item Name	Qty	Image
1	MG996R Servo Motors 180 degrees, 11kgcm torque	2	
2	Robokits High Torque Digital Waterproof Servo Motor 180° 20Kgcm	3	
3	Orange Jhonson DC Geared Motor, 12V, 600rpm	4	
4	4 Battery Holder	1	
5	Omni Wheels 58mm	4	
6	600rpm RPM N20 gear Motor	2	
7	L298n Motor Driver 5V-35V 2A	3	
8	Nano Board R3 CH340 chip With USB Mini Cable 5v	1	
9	3 battery holder	1	
10	KCD5-101-Mini Rocker Switch-2Pin(ON-OFF) 6A 125VAC/3A 250VAC	1	
11	HC-SR04-Ultrasonic sensor	1	
12	Smart Elex RLS-08 Analog & Digital Line Sensor Array	1	
13	Infrared Obstacle Avoidance IR Sensor Module	4	
14	1.8 Inch TFT LCD Module 128 x 160 with 4 IO	1	

15	Robot Wheels Diameter: 65 mm Width : 28 mm	2	
16	ESP32-WROOM-32 38Pin Development Board	3	
17	5V 1 Channel Relay Module Maximum Switching Voltage: 250VAC@10A; 30VDC @10A	2	
18	12V to 5V buck convertor	1	
19	5Kg Load cell with hx711 module	1	
20	DC6-12V MINI Aquarium Water Pump R365	1	
21	jumper wires male to male	100	
22	jumper wires Female to Female	100	
23	jumper wires male to female	100	
24	22 AWG wires (black and red) each 10mtrs	10 m	
25	Filaments (kg)	2 Kg	Reimbursement at a rate of <b>₹800 per kg</b> , for a maximum of <b>2 kg of 3D printing material</b> , will be processed upon submission of the <b>photographs of the components</b> .
26	ARENA PCB	1	
27	Motor Controller board SARM	1	
28	Line Follower PCB	1	
29	Lam LED PCB	1	
30	Screws & Fasteners	1 Set	

## LIST OF FASTERNERS

S.NO	NAME( PURPOSE)	SIZE- LENGTH	Qty	SPECIFICATIONS	IMAGE
<b>ALFR</b>					
1	M3 Hex socket flat head cap bolt (battery holder)	12	3	M3 X 12mm Hex (Allen) CSK SS 304 Screw (Dia. 3mm, Length 12mm)	
2	M3 Hex socket head cap bolt 16 (Motor Mounts)	16	4	M3 X 16mm Hex (Allen) Socket Head SS 304 Screw (Dia. 3mm, Length 16mm) DIN 912	
3	M3 Hex socket head cap bolt 12 (IR Sensor Array)	12	4	M3 X 12mm Hex (Allen) Socket Head SS 304 Screw (Dia. 3mm, Length 12mm) DIN 912	
4	M2.5 Hex socket head cap bolt 16 (PCB)	16	8	M2.5 X 16mm Hex (Allen) Socket Head SS 304 Screw (Dia. 2.5mm, Length 16mm)	
5	M3 Philips Pan Head 25 (Castor Wheel)	25	3	M3 X 25mm Phillips Pan head SS 304 Screw (Dia. 3mm, Length 25mm)	
6	M3 Hex Nuts	-	14	M3 Hex Nut SS304 (Dia. 3mm)	
7	M2.5 Hex Nuts	-	4	M2.5 Hex Nut SS304 (Dia. 2.5mm)	
<b>OMNI WHEEL PLATFORM WITH SINGLE ARM ROBOT</b>					
1	M4 Philips Counter Sunk Self Tapping Screw (Base of Robotic Arm)	10	4	M4 X 10mm Phillips CSK SS 304 Screw (Dia. 4mm, Length 10mm)	
2	M3 Hex socket flat head cap bolt (To Fix Servo motors)	10	24	M3 X 10mm Hex (Allen) CSK SS 304 Screw (Dia. 3mm, Length 10mm)	
3	M3 Hex socket flat head cap bolt (Gripper and link 2,3)	16	26	M3 X 16mm Hex (Allen) CSK SS 304 Screw (Dia. 3mm, Length 16mm)	

4	M3 Washers (Servo motors and gripper)	-	40	M3 Washer SS304 (Dia. 3.2mm)	
5	M3 HexNut	-	26	M3 Hex Nut SS304 (Dia. 3mm)	
6	M4 Hex socket button head cap bolt (Mobile Base –Basecap, PCB holder)	16	8	M4 X 16mm Hex (Allen) Socket Head SS 304 Screw (Dia. 4mm, Length 16mm)	
7	M4 Hex socket button head cap bolt (PCB)	12	4	M4 X 12mm Hex (Allen) Socket Head SS 304 Screw (Dia. 4mm, Length 12mm)	
8	M4 Hex Nuts		4	M4 Hex Nut SS304 (Dia. 4mm)	
9	M4 Brass inserts ((Mobile Base –Basecap, PCB holder))	6	8	M4 X 6mm Brass Threaded Inserts (Dia. 4mm, Length 6mm)	
10	M3 Brass Threaded inserts (Servo motors)	4	24	M4 X 4mm Brass Threaded Inserts (Dia. 4mm, Length 4mm)	
11	M2.5 Hex socket head cap bolt (Mobile Base – Motor Mounts)	20	8	M2.5 X 20mm Hex (Allen) Socket Head SS 304 Screw (Dia. 2.5mm, Length 20mm)	
12	M2.5 Hex Nuts	-	8	M2.5 Hex Nut SS304 (Dia. 2.5mm)	
13	M3 Hex socket flat head cap bolt (Bushes of the Mobile Base)	10	4	M3 X 10mm Hex (Allen) CSK SS 304 Screw (Dia. 3mm, Length 10mm)	

# Scoring Table

S.No	Description	Marks
1	Development of the Arena Circuit with Pump & LCD Screen display.	100
2	The <b>Single Arm Robot (SARM)</b> with an <b>Omni-Wheeled Platform</b> is to be <b>3D printed by the team</b> . A <b>3D model</b> is available in the shared drive. Please note that the <b>gripper requires modification</b> to enable the <b>SARM to operate effectively and lift obstacles efficiently</b> .	50
3	<b>The Advanced Line Follower Robot (ALFR)</b> is to be 3D printed. The 3D models of the ALFR and motor connectors are available in the shared drive. A successful demonstration of the line-following operation should be included as part of the video submission.	50
4	ALFR Successfully Crosses Obstacle – Stage 1	50
5	ALFR Successfully Crosses Obstacle – Stage 2	50
6	ALFR Successfully Crosses Obstacle – Stage 3	50
7	Design & Development of Peristaltic Pump	25
8	Make a Unique Document where your Identity reflects.	25
9	Time Bonus – Each 1 min saved (under 10 min)	+5 per min
10	An extra bonus – Product design and Aesthetic of the Arena, SARM, ALFR or any activity which impress us	100
	<b>Total (excluding bonus)</b>	<b>500</b>

## Submission Guidelines:

- Provide a video demonstrating the key points listed above. The total real-time duration of your Advanced Line Follower should be 10 minutes.
- A video of your journey of your journey should be submitted along with the above working video.