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# Sample Test Project

**District / Zonal Skill Competitions**

**Skill- Mobile Robotic**

*Category: Manufacturing & Engineering Technology*

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## Section - A

### *A. Preface*

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#### **Skill Explained:**

Robotics is the branch of technology that deals with the design, construction, operation, structural disposition and application of robots. Mobile Robotics is a fast evolving, solutions orientated. Industrial mobile robotics is an important part of the industry, with applications in diverse industries, including manufacturing, agriculture, aerospace, mining, and medicine. Presently there is a need to create robots to increase the capacity for tasks that can be automated. The competitors are expected to develop a test project to solve a real time industrial application with a total automated solution.

#### **Eligibility Criteria (for IndiaSkills 2018 and WorldSkills 2019):**

Competitors born on or after 01 Jan 1997 are eligible to attend the Competition. The team consists of 2 competitors.

**Total Duration: 5 Hrs**

## Section - B

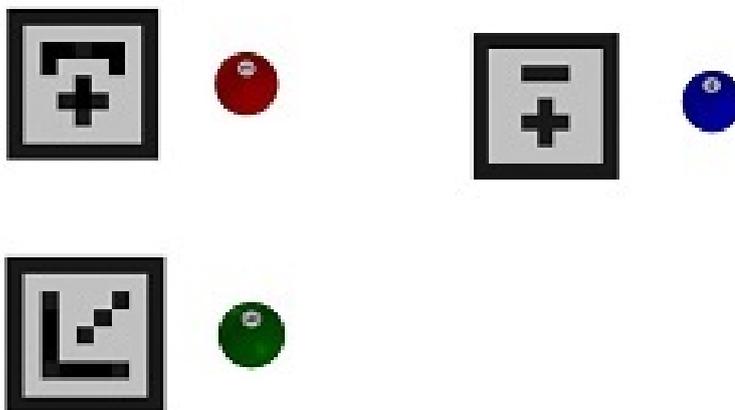
### B. Test Project

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Competitors are required to study and fabricate a robot on the guidelines of the declared test project. The Sample Test Project is subjected to a 10 to 20% change. However, changes shall not require any change in the infrastructure requirements. The competitors shall be required to submit a soft copy of the technical documentation of the fabricated robot. The documentation shall include The Frame / Structural Elements Organization, The Wiring System Organization, The Mobility Management System Organization, The Object Management System Organization, The Computer Programming Organization.

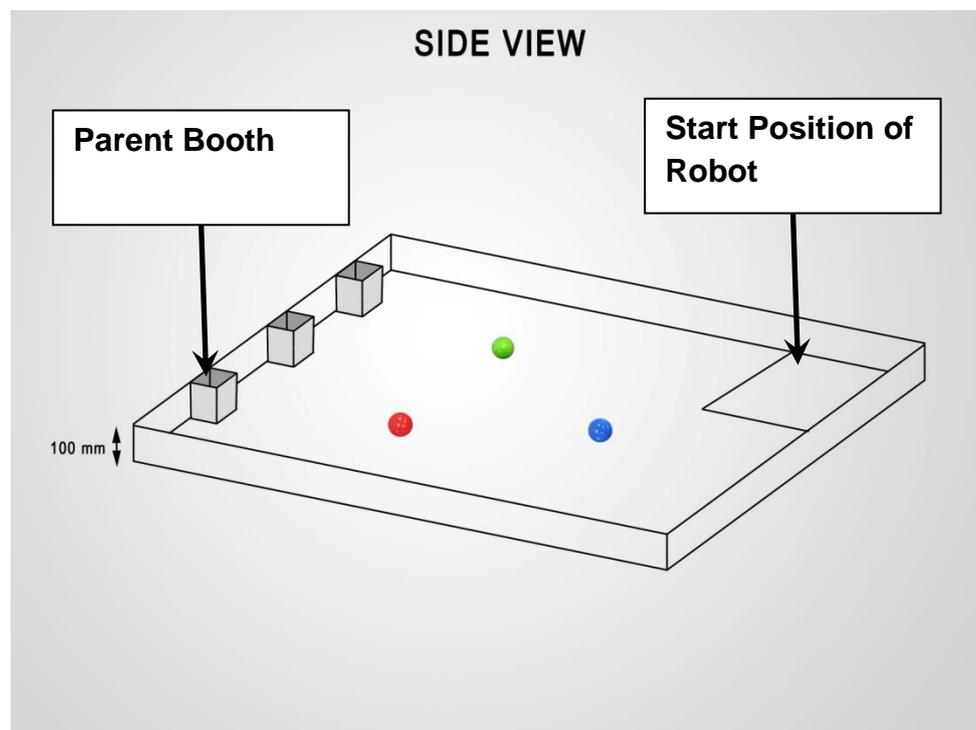
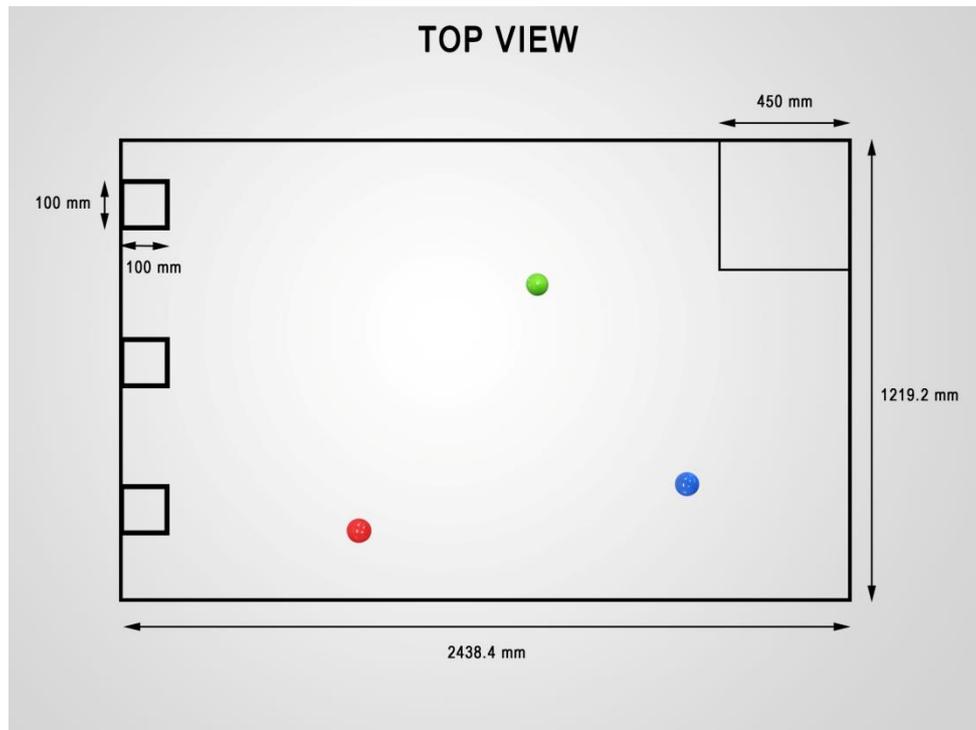
Robot structure shall be fabricated by the competitors prior to the competition, no readymade structural components shall be used by the competitors. However, Robot shall be dismantled and reassembled at the competition venue.

The children are playing in the playground. The parents are waiting outside the game field. The task of the robot is to deliver the child to the corresponding parent. A set of plastic solid colour balls of diameter 2.25 inches (Red, Green, Blue), will fill the role of 'Children' in the Playground Monitor Robot Task and grid patterns shall play the role of parents. The Competitor Built Robots Task is to travel from the Playground, pick up the Designated 'Child of Interest' and deliver each of the Child to the Correct Parent. The Teams shall get maximum 10 minutes to pick up 3 Children. Competitors will Design / fabricate and Operate an Object Management System with the capabilities to manage / operated through wired and manually operated mode. The Object Management System and the Robot in combination can be in possession of a Maximum of ONE Child at a time.



The Playground reception area

The Playground top view and isometric view is as follows:



- The game field shall be a court of area 4 ft. X 8 ft.
- A Row of three hollow Parent Booth of size 100 mm X 100mm with 100mm height.
- The Parent Grid Patterns will be pasted on the parent booth.

- The Designated Robot Starting Position is Inside a 450 by 450 mm Tape Line Square at the end of the reception area.
- The Competitor Built Robots Task is to travel from the Playground pickup one ball at a time, and delivered (to be placed inside the hollow area) to each of the Correct Parent.
- The Teams will get maximum 10 minute to deliver all three Children.

## Section – C

### C. Marking Scheme

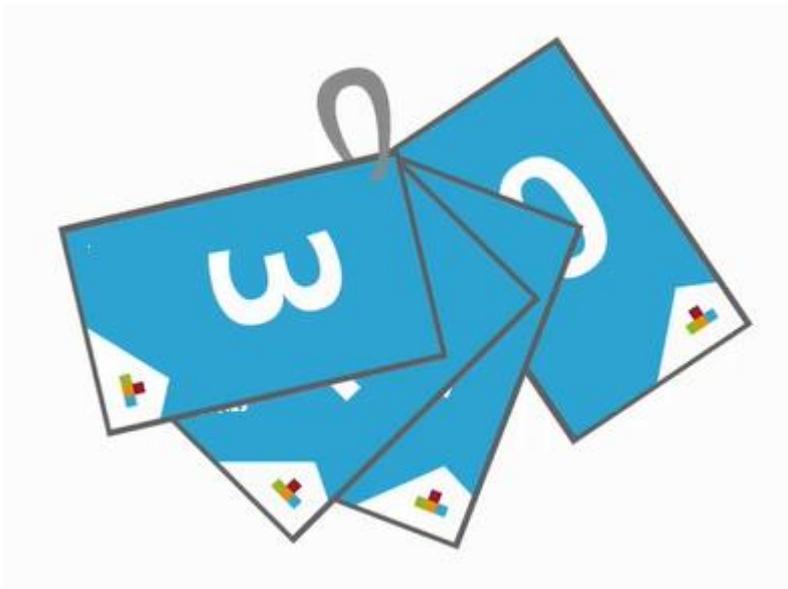
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The Assessment is done by awarding points by adopting two methods, Measurement and Judgments

- Measurement(M) –One which is measurable
- Judgments(J)-Based on Industry expectations

#### Method:

Flash cards are used for judgmental as shown in figure below.



- Three experts do judgment
- Experts secretly select a score between 0 and 3.
  - 0: performance below industry standard
  - 1: performance meets industry standard
  - 2: performance meets and, in specific respects, exceeds industry standard
  - 3: performance wholly exceeds industry standard and is judged as excellent
- Experts display their scores at the same time and these scores are recorded.
- The set scores awarded must not differ by more than 1.
  - If the scores differ by more than one, discussion is allowed, with reference to the detailed descriptor for each score, in order to bring the scores into the permitted range.

## **Example-Judgment Marking**

If maximum marks for Judgment criteria is 1 and if all 3 Experts (Juries) give 3 points to a candidate, the candidate will get 1 mark for that aspect. If 2 Experts give 3 and 1 Expert gives 2 points, then candidate will get  $(3+3+2)/9*1 = 0.89$  marks for that aspect out of 1 mark.

### **The tasks for performance with allocation of marks are as follows;**

- Criteria A - Work organization & Management - 10 Marks
- Criteria B - Communication & Interpersonal Skills – 10 Marks
- Criteria C – Design – 25 Marks
  - Base Unit Core mobility performance
  - Simple Object Handling Task
  - Fabrication and Assembly
- Criteria D - Fabrication & Assembly – 20 Marks
- Criteria E - Programming, Testing & Adjustment – 35 marks

**The Detailed Marking Form is attached as Annexure**

## Section - D

### D. Infrastructure List

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**The Organizers are responsible to arrange for the Play Field of Particle Board.**

**The Items required for the Competitions are as follows;**

- Particle board of 4 ft. by 8 ft with a white PVC sheet coating on one side.
- Black Electrical insulation tape.
- Grid pattern printed on white paper of size 80 mm X 80 mm.
- No restriction for use any sponsored / make of components.
- The competitors can use any microcontroller, programming tools of their choice for level – I competition, however, Competitors shall be encouraged to use the components from National Instruments LabVIEW and myRIO controller (As these are the mandatory components for later levels of the competition)

It shall be the responsibility of the competitors to arrange for the components.

## Section – E

### E. Instructions for candidates

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- Experts shall not be allowed to give any help to Competitors to interpret the Test Project except where agreed by the Jury before the start of the competition
- Competitors have the right to expect fairness, honesty, and transparency during the Competition
- Every Competitor has the right to expect that no other Competitor will receive unfair assistance or any intervention that may provide an advantage
- Interference by officials or spectators that may hinder or assist Competitors in the completion of their Test Project is forbidden
- Accredited personnel at the Competition shall ensure that the above principles of honesty, fairness and transparency are observed at all times
- When the Competition is over, Competitors shall be given time to exchange views and experiences with other Competitors and Experts.
- In case a Competitor has to withdraw due to illness or accident; marks will be awarded for the work completed.
- In the event of Competitor fall ill or has an accident must be informed to Expert (Jury member)

## Section – F

### F. Health, Safety, and Environment

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Following are the suggested personal protective equipment's during the competition.

- Safety footwear - Mandatory and all time
- Protective gloves - While doing drilling operation  
(If Required)
- Protective glasses / face protection - While doing drilling operation  
(If required)

1. All accredited participants and supporting volunteers will abide by rules and regulations with regards to Health, Safety, and Environment of the Competition venue.
2. All participants will assume liability for all risks of injury and damage to property, loss of property, which might be associated with or result from participation in the event. The organizers will not be liable for any damage; however in case of Injury the competitor will immediately inform the immediate organizer for medical attention.

## Annexure – Detailed Assessment Sheet

### Details of marking for Aspects of sub Criteria A1 and A2

J: Judgment Assessment M: Measurement Assessment

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
A1	5	Work Organization & Management	J	Co-operative Behaviour with Compatriot Team Member
Workspace management is an on-going requirement. Workspace Status Evaluations will be conducted at Random Times throughout the Competition. Safety and Efficiency are the primary goals of workspace management and the placement of tools, materials will be viewed from the perspective of whether or not they are contributing to a safe and efficient workspace.				
0	Always Non-cooperative behaviour with other competitors. Always Taking possession of shared game field more than the allotted time. Always Not reporting to game field in time.			
1	Occasional Non-cooperative behaviour with other competitors. Occasionally taking possession of shared game field more than the allotted time. Occasionally Not reporting to game field in time.			
2	Very cooperative behaviour with other competitors. Clearing the shared game field in the allotted time. Always reporting to game field in time.			
3	Excellent cooperative behaviour with other competitors. Clearing the shared game field in the allotted time and hand over the game field in clean condition. Always reporting to game field in time.			
Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
A2	5	Work Organization & Management	J	Team Space Condition
0	Workspace is consistently in a state of disarray: multiple tools and components on the floor / significant number of tools not in use are scattered about on the work bench / NO clearly defined work area for each competitor			
1	Workspace is consistently in a moderate state of organization: Tools and components are rarely on the floor / A small number of tools not in use scattered about on the work bench / Each Competitor has a moderately defined work area			
2	Workspace is consistently in a good state of organization: NO tools and components on the floor / No significant number of tools not in use scattered about on the work bench / Each Competitor has a clearly defined work area			
3	Workspace is consistently in an excellent state of organization: Tools and components are never left on the floor / NO Tools not in use scattered about on the work bench / Each Competitor has an exceptionally well-defined workspace			

### Details of marking for Aspects of sub Criteria B1 to B5

J: Judgment Assessment M: Measurement Assessment

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
B1	2	Communication and Interpersonal Skills	J	Review of the Engineering Journal Frame / Structural Section
0	Incoherent content organization, lacking in detail and containing a poor quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is NOT evident in the Journal content			
1	Coherent content organization, adequate in detail and containing a reasonable quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is somewhat apparent in the Journal content			
2	Very Coherent content organization, more than adequate in detail and containing a good quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is clearly evident in the Journal content			
3	Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is exceptionally evident in the Journal content			
Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
B2	2	Communication and Interpersonal Skills	J	Review of the Engineering Journal Wiring Section
0	Incoherent content organization, lacking in detail and containing a poor quality of diagrams / schematics. Adherence with Industry Wiring Standards is NOT evident in the Journal content.			
1	Coherent content organization, adequate in detail and containing a reasonable quality of diagrams / schematics. Adherence with Industry Wiring Standards is reasonably apparent in the Journal content.			
2	Very Coherent content organization, more than adequate in detail and containing a good quality of diagrams / schematics. Adherence with Industry Wiring Standards is very evident in the Journal content.			
3	Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of diagrams / schematics. Adherence with Industry Wiring Standards is exceptionally evident in the Journal content.			

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
B3	2	Communication and Interpersonal Skills	J	Review of the Engineering Journal Mobility Management Section
0	Incoherent content organization, lacking in detail and containing a poor quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are NOT evident in the Journal content			
1	Coherent content organization, adequate in detail and containing a reasonable quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are reasonably evident in the Journal content			
2	Very Coherent content organization, more than adequate in detail and containing a good quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are more than adequately evident in the Journal content			
3	Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are exceptionally evident in the Journal content			
Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
B4	2	Communication and Interpersonal Skills	J	Review of the Engineering Journal Object Management Section
0	Incoherent content organization, lacking in detail and containing a poor quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are NOT evident in the Journal content			
1	Coherent content organization, adequate in detail and containing a reasonable quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are reasonably evident in the Journal content			
2	Very Coherent content organization, more than adequate in detail and containing a good quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are more than adequately evident in the Journal content			
3	Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of drawings / diagrams. The foundation strategy and functional			

	elements on which the Object Management System is based are exceptionally evident in the Journal content			
Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
B5	2	Communication and Interpersonal Skills	J	Review of the Engineering Journal Computer Programming Section
0	Incoherent content organization, lacking in detail and containing a poor quality of diagrams / flow charts. The foundation strategy and organizational structures on which the Computer Program Files are based are NOT evident in the Journal content			
1	Coherent content organization, adequate in detail and containing a reasonable quality of diagrams / flow charts. The foundation strategy and organizational structures on which the Computer Program Files are based are reasonably evident in the Journal content			
2	Very Coherent content organization, more than adequate in detail and containing a good quality of diagrams / flow charts. The foundation strategy and organizational structures on which the Computer Program Files are based are more than adequately evident in the Journal content			
3	Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of diagrams / flow charts. The foundation strategy and organizational structures on which the Computer Program Files are based are exceptionally evident in the Journal content			

### Details of marking for Aspects of sub Criteria C1.1 to C 2.4

J: Judgment Assessment M: Measurement Assessment

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
C1.1	4	Distance Sensor Performance	M	A Flat Plate is brought into the Sensor Field and the Robot must make a predetermined response such as Blink a LED at a button press.
C1.2	2	IR Tape Line Sensor Performance	M	A Flat Plate with a Black Tape Line on it is brought into the Sensor Field and the Robot must make a predetermined response such as such as Blink a LED at a button press.
C2.1	2	Straight Line in a Forward Direction	M	The Robot must complete a 1 M Forwards movement in the Open Playground Smooth Floor Space
C2.2	2	Straight Line in a Backwards Direction	M	The Robot must complete a 1 M Backwards movement in the Open Playground Smooth Floor Space
C2.3	5	360 Degree Rotation within a 600 by 600 mm space	M	The Robot must complete a Full 360 degree rotation while remaining in a Tape Line defined Square
C2.4	10	Object Management System: (Ball Pick Up)	M	The Robot is placed in a position of the Team's choosing relative to a Designated Ball on the game field. The robot has to pick up the ball and hold it without touching the ground.

### Details of marking for Aspects of sub Criteria D1 to D3

J: Judgment Assessment M: Measurement Assessment

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
D1	4	Wiring	M	Wiring installation meets Industry Standards for secure / safe installation Examination of the Robot's Wiring (secure wire placement, efficient wire organization, quality of connections, protection from Abrasion, inclusion of appropriate fusing and master safety switch)
0				Wire placement is poorly organized. Multiple wires are loose and tangled. An excessive amount of wire is used. No wiring labels present. Connections are loose. Excessive amounts of wire is exposed at connections. Wires are positioned where they are at risk of abrasion damage due to component movement. Fuses are positioned where they are not easily accessed. Master safety switch is not readily accessible.
1				Wire placement is reasonably organized. Minimal wires are loose and tangled. Amount of wire used is reasonable. Majority of Wires are labeled. Connections are reasonably secure. A reasonable amount of wire is exposed at connections. Wires are positioned where they are at minor risk of abrasion damage due to component movement. Fuses are positioned where they are can be reasonably accessed. Master safety switch is reasonably accessible.
2				Wire placement is very well organized. No wires are loose and tangled. Amount of wire used is efficient. Majority of Wires are labeled. Connections are secure. An appropriate amount of wire is exposed at connections. Wires are positioned where they are Minimally at risk of abrasion damage due to component movement. Fuses are positioned where they are can be adequately accessed. Master safety switch is adequately accessible.
3				Wire placement is exceptionally well organized. No wires are loose and tangled. Amount of wire used is very efficient. All Wires are labeled. All connections are secure. An minimal amount of wire is exposed at connections. Wires are positioned where they are Not at risk of abrasion damage due to component movement. Fuses are positioned where they are can be easily accessed. Master safety switch is easily accessible.

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
D2	Max. 8	Robot Frame	J	Frame Assembly meets Industry Standards for fit and alignment of components Examination of the Robot Frame's Structural Integrity (fit between connected components, accuracy of component alignment angles, sizes etc.)
0	Overall Robot Frame is poorly organized. Multiple structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. An excessive amount of structural elements are used. The robot base is an unstable platform presenting a poor degree of support to the Object Management System.			
1	Overall Robot Frame is reasonably well organized. A minimal number of structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. A reasonable amount of structural elements are used. The robot base is a moderately stable platform presenting a reasonable degree of support to the Object Management System.			
2	Overall Robot Frame is very well organized. No structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. An effective amount of structural elements are used. The robot base is a very stable platform presenting an effective degree of support to the Object Management System.			
3	Overall Robot Frame is exceptionally well organized. No structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. A very efficient amount of structural elements are used. The robot base is an exceptionally stable platform presenting an very effective degree of support to the Object Management System.			

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
D3	Max. 8	Object Management System Structural Elements	J	Object Management System meets Industry Standards for fit and alignment of components Examination of the Object Management System's Structural Integrity (fit between connected components, accuracy of component alignment angles, sizes etc.)
0	Overall Object Management System is poorly organized. Multiple structural element connections are loose allowing for for unexpected / unintended joint movement when either a fixed positional relationship between structural elements or a controlled relationship between moving elements is required. An excessive amount of structural elements are used. The relationship between the Object Management System's Primary Elements (The Handling Mechanism and Reaching Mechanism) is poorly co-ordinated.			
1	Overall Object Management System is reasonably organized. Minimal structural element connections are loose leading to minimal unexpected / unintended joint movement when either a fixed positional relationship between structural elements or a controlled relationship between moving elements is required. An reasonable amount of structural elements are used. The relationship between the Object Management System's Primary Elements (The Handling Mechanism and Reaching Mechanism) is reasonably co-ordinated.			
2	Overall Object Management System is very well organized. No structural element connections are loose leading to no unexpected / unintended joint movement when either a fixed positional relationship between structural elements or a controlled relationship between moving elements is required. An effective amount of structural elements are used. The relationship between the Object Management System's Primary Elements (The Handling Mechanism and Reaching Mechanism) is very well co-ordinated.			
3	Overall Object Management System is exceptionally well organized. No structural element connections are loose leading to no unexpected / unintended joint movement when either a fixed positional relationship between structural elements or a controlled relationship between moving elements is required. An exceptionally effective amount of structural elements are used. The relationship between the Object Management System's Primary Elements (The Handling Mechanism and Reaching Mechanism) is exceptionally well co-ordinated.			

### Details for measurement marking for Sub Criteria E1 to E4.6

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
E1	5	Mobility Management: Safety Light	M	The Safety Light functionality is observed through a series of Robot turned ON / OFF experiences (i.e Light should be on whenever the robot is moving or in operation and off when robot is not in motion and non operation mode)
E2.1	2	Mobility Management: Movement in a Confined Space without the use of Camera Based Information	M	Robot exits out of the start position and travels the length of the game field to first parents booth
E2.2	2		M	Robot exits out of the start position and travels the length of the game field to second parents booth
E2.3	2		M	Robot exits out of the start position and travels the length of the game field to third parents booth
E3.1	1	Mobility Management: Moving the Robot to Designated Parent Booths	M	Robot successfully positions itself in front of Designated first Parent Grid Pattern
E3.2	1		M	Robot successfully positions itself in front of Designated Second parent Grid Pattern One
E3.3	1		M	Robot successfully positions itself in front of third Designated Parent Grid
E3.4	3		M	Successfully delivers the ball into the first parent booth.
E3.5	3		M	Successfully delivers the ball into the second parent booth
E3.6	3		M	Successfully delivers the ball into the third parent booth

Aspect ID	Max. Mark	Details of Aspect	Type of Assessment	Aspect of sub criteria - Description Comment
E4.1	1	Mobility Management: Moving the Robot to Designated Parent Booths	M	Robot successfully positions itself in front of Designated first Parent Grid Pattern
E4.2	1		M	Robot successfully positions itself in front of Designated Second parent Grid Pattern One
E4.3	1		M	Robot successfully positions itself in front of third Designated Parent Grid
E4.4	3		M	Successfully delivers the ball into the first parent booth.
E4.5	3		M	Successfully delivers the ball into the second parent booth
E4.6	3		M	Successfully delivers the ball into the third parent booth



<b>Aspect ID</b>	<b>Description</b>	<b>Max. Marks</b>	<b>Marks Obtained</b>
<b>D</b>	<b>Fabrication &amp; Assembly</b>	<b>20.00</b>	
D 1	Wiring installation meets Industry Standards for secure / safe installation Examination of the Robot's Wiring (secure wire placement, efficient wire organization, quality of connections, protection from Abrasion, inclusion of appropriate fusing and master safety switch)	4.00	
D 2	Frame Assembly meets Industry Standards for fit and alignment of components Examination of the Robot Frame's Structural Integrity (fit between connected components, accuracy of component alignment angles, sizes etc.)	8.00	
D 3	Object Management System meets Industry Standards for fit and alignment of components Examination of the Object Management System's Structural Integrity (fit between connected components, accuracy of component alignment angles, sizes etc.)	8.00	
<b>E</b>	<b>Core Programming, Testing &amp; Adjustment</b>	<b>35.00</b>	
E 1	The Robot's operational Safety Light Performance	5.00	
E 2.1	Robot exits out of the start position and travels the length of the game field to first parents booth	2.00	
E 2.2	Robot exits out of the start position and travels the length of the game field to second parents booth	2.00	
E 2.3	Robot exits out of the start position and travels the length of the game field to third parents booth	2.00	
E 3.1	Robot successfully positions itself in front of Designated first Parent Grid Pattern	1.00	
E 3.2	Robot successfully positions itself in front of Designated Second parent Grid Pattern One	1.00	
E 3.3	Robot successfully positions itself in front of third Designated Parent Grid	1.00	
E 3.4	Successfully delivers the ball into the first parent booth.	3.00	
E 3.5	Successfully delivers the ball into the second parent booth	3.00	
E 3.6	Successfully delivers the ball into the third parent booth	3.00	

<b>Aspect ID</b>	<b>Description</b>	<b>Max. Marks</b>	<b>Marks Obtained</b>
E4.1	Robot successfully positions itself in front of Designated first Parent Grid Pattern	1.00	
E4.2	Robot successfully positions itself in front of Designated Second parent Grid Pattern One	1.00	
E4.3	Robot successfully positions itself in front of third Designated Parent Grid	1.00	
E4.4	Successfully delivers the ball into the first parent booth.	3.00	
E4.5	Successfully delivers the ball into the second parent booth	3.00	
E4.6	Successfully delivers the ball into the third parent booth	3.00	