DIRECTORATE GENERAL OF VOCATIONAL AND TECHNICAL EDUCATION

100 CENTURY OF EDUCATION

TÜBİTAK

TİKA

INTERNATIONAL MEB ROBOT COMPETITION

17th INTERNATIONAL MEB ROBOTICS COMPETITION

UNDERWATER ROBOTS (SAR) CATEGORY COMPETITION RULES

2025

Education, Technology, Production from Roots to the Future

CONTENTS

UNDERWATER ROBOTS (SAR) CATEGORY RULES

1. GENERAL INFORMATİON ABOUT THE COMPETİTİON

1.1. Theme

In this competition, you will have the opportunity to showcase your engineering skills by designing robots capable of maneuvering in underwater depths, while also experiencing the use of technology for the benefit of humanity and nature. The tasks in this competition focus on real-world problems and will test your robots' precision control abilities, their potential to contribute to the ecosystem by creating artificial reefs, and their ability to detect and eliminate pollution. This process supports the development of robots that contribute to the preservation of underwater ecosystems and scientific research through underwater technologies.

1.2. Objective

The **Underwater Robots (SAR) Competition** aims to enable students to design unmanned vehicles capable of performing underwater tasks using modern technologies. In addition to supporting the development of unmanned vehicles, which are considered the technology of the future, the competition also seeks to promote technological advancements and R&D processes related to underwater tasks at both secondary and university levels. During this process, students are expected to access information, utilize it effectively, analyze and solve encountered problems, and explore new technologies.

2. COMPETITION FEATURESI

In the **MEB Underwater Robots Competition**, participating teams are expected to design an unmanned underwater vehicle capable of maneuvering through an underwater course and performing tasks such as dragging and carrying objects.

Competitors applying for the **17th International MEB Underwater Robot (SAR) Category** must read the **Application Guide**, which includes the competition application process and general category rules, available at https://robot.meb.gov.tr under the "Organization" menu.

Please do not forget to regularly check the **MEB Robot Competitions** website for announcements and updates related to the **Underwater Robots (SAR) Category**!

2.1. Scoring, Evaluation, Competition Courses, and Task Objects

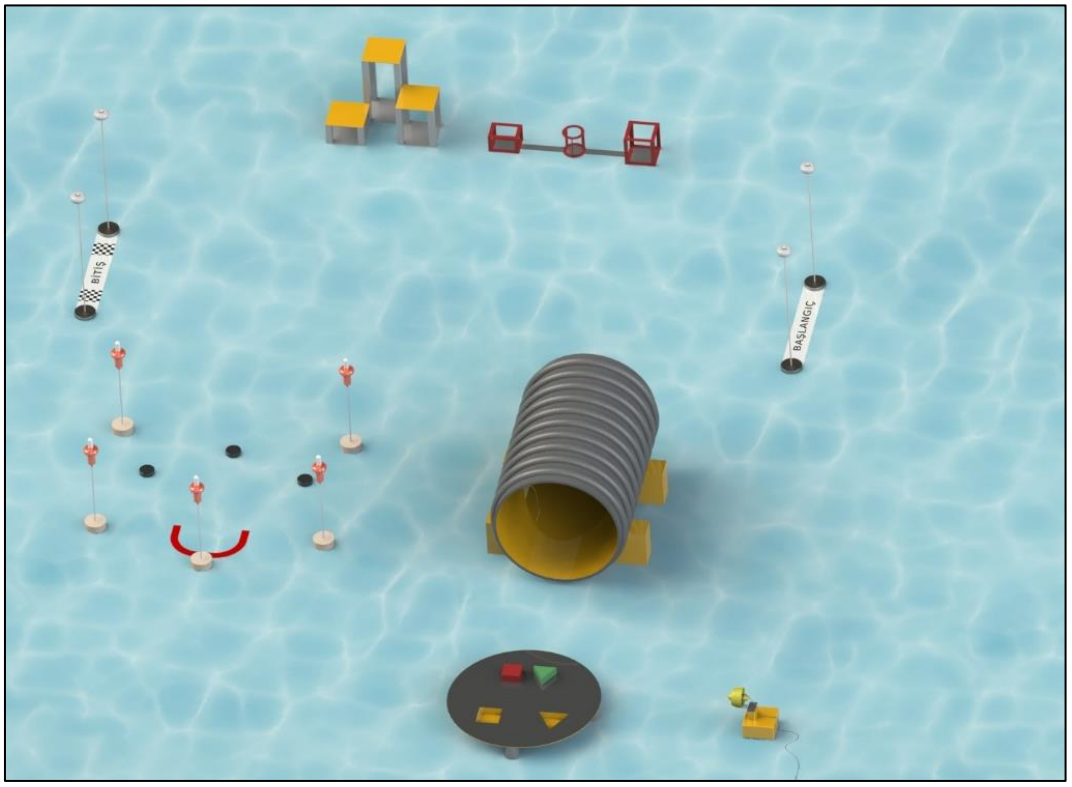

***Figure 3.1**: Underwater Robots Competition Pool and Task Overview*

The competition will take place in a pool with a depth of 140 cm, a width of 1250 cm, and a length of 2500 cm. Platforms will be placed inside the pool to mark the start and finish areas. The competition course, where the tasks will be performed, will be set up by referees before the competition. Each team will position their underwater vehicle at the starting point, and once the referee signals the start of the competition, they must pass through the starting area to begin.

Competing teams are expected to complete four different tasks using their underwater vehicles. There is no required order of priority for these tasks; each task is scored independently. One of these tasks is passing through a pipe placed on the pool floor. Another task involves placing designated task objects into the correct slots on a table-like platform fixed to the pool floor, despite artificial water currents. Another task requires the underwater robot to collect three cylindrical balls and place them in a U-shaped area, regardless of the order. The final task involves transporting three task objects of different sizes and shapes from their original locations to table-like platforms of varying heights. Figure 3.2 illustrates the competition course.

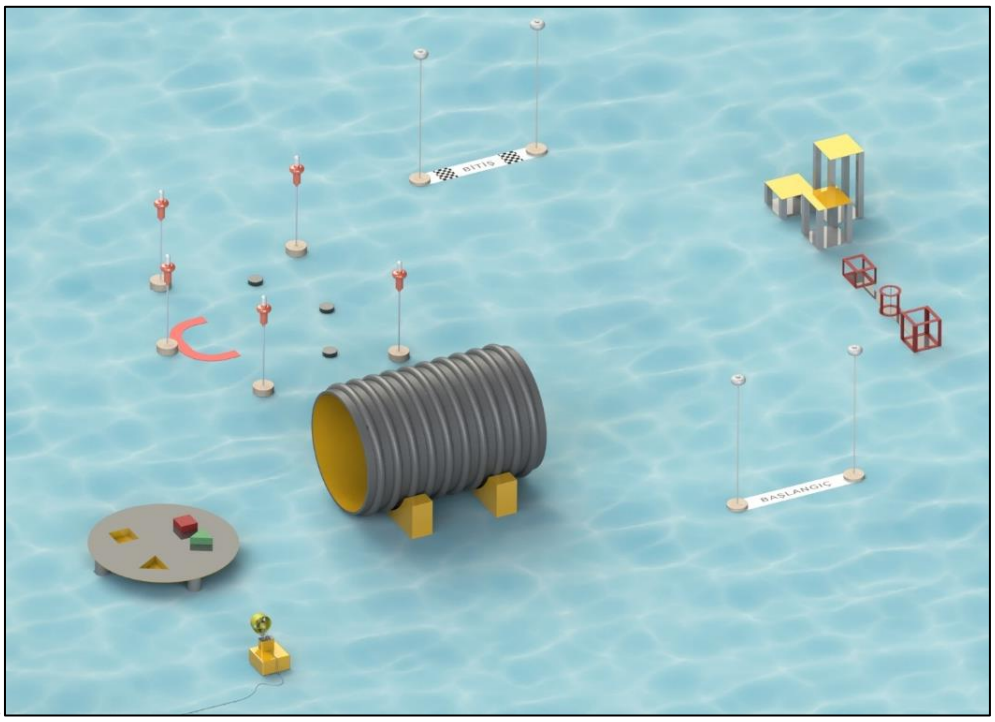

Figure 3.2: *Underwater Robot Competition Course*

2.1.1. Buoy-Based Start and Finish Platforms

After the preparation period, the underwater robot will be considered to have entered the competition course once it passes through the **Start Buoy Platform**, and the competition time will begin. During the allocated preparation time, teams are expected to position their vehicle in front of the start buoy, ready to begin the competition.Once the referee signals the start of the competition, teams are required to complete their tasks within the competition time and then pass through the **Finish Buoy Platform**. **Figure 3.3** shows the start buoy platform, while **Figure 3.4** illustrates the finish buoy platform.

Figure 3.3*: Start Buoy Platform*

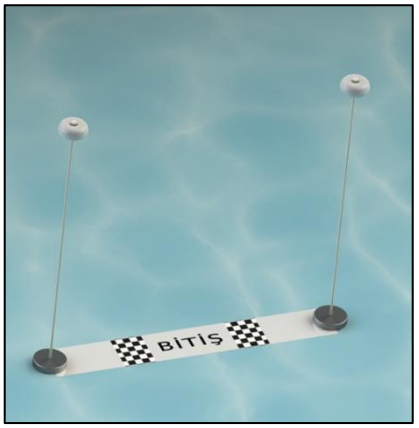

Figure 3.4: *Finish Buoy Platform*

The buoys on the buoy platforms in **Figures 3.3** and **3.4** will be positioned at a height of **1000 mm** above the pool floor, with a distance of **860 mm** between the centers of the two buoys. Vehicles passing through the start and finish buoy platforms will not receive additional points. However, the time at which a vehicle passes through the finish buoy platform will be considered the **finish time** by the referees, as displayed on the stopwatch screen at that moment. The time will be determined when any part of the underwater robot passes through the finish buoy platform.

2.1.2. Passing Through the Pipe Task

In this task, the competing teams' underwater robots are expected to enter one end of a hollow cylindrical pipe, which has an inner diameter of 800 mm and a length of 1300 mm, and exit from the other end. The team that successfully passes their robot through the pipe and out of the other end will receive 10 points. If the robot moves the pipe platform, which is supported by wedges, from its position, the team will lose 5 points. Not passing through the pipe does not prevent teams from reaching the finish line and completing the competition.

The visual for this task is shown in Figure 3.5.

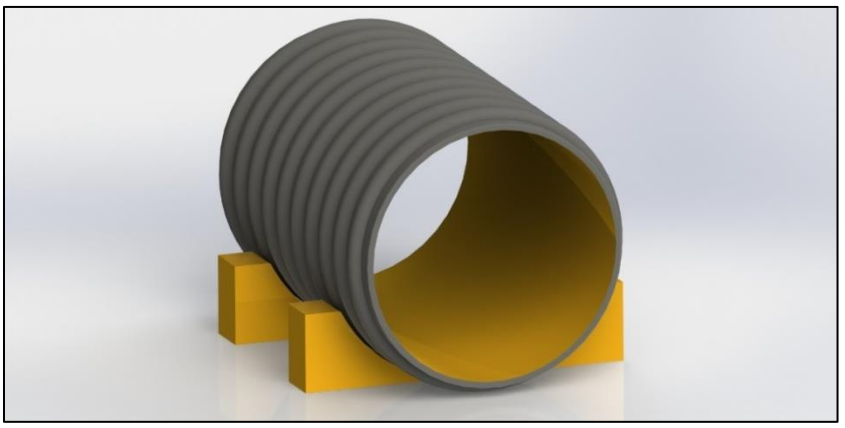

Figure 3.5: *Passing Through the Pipe Task*

2.1.3. Object Placement in Underwater Current Task

this task, an artificial current will be created with the help of an underwater motor. Despite the created current, the competing teams' underwater robots are expected to place equilateral triangle and rectangular prism shaped objects into the corresponding openings of an equilateral triangle and square on a table-like platform fixed to the pool floor.

The visual for this task is shown in Figure 3.6.

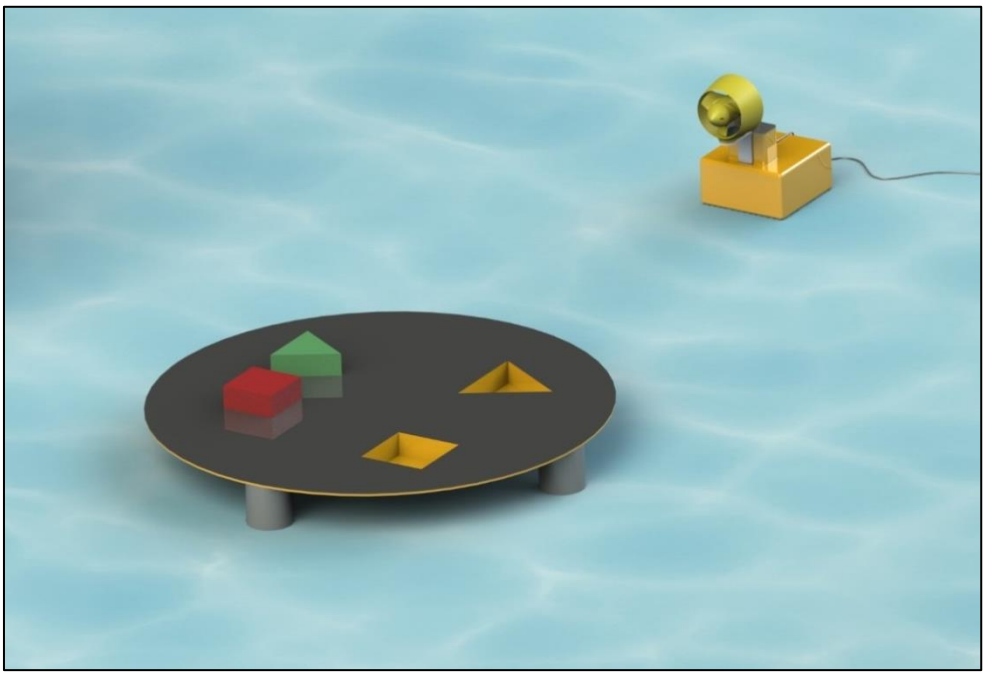

Figure 3. 6: *Object Placement in Underwater Current Task*

The table-like platform, on which the task objects are placed, has a height of **105 mm** above the pool floor, a **diameter of 1000 mm**, and a platform thickness of **5 mm**. The technical details of the platform are shown in **Figure 3.7**.

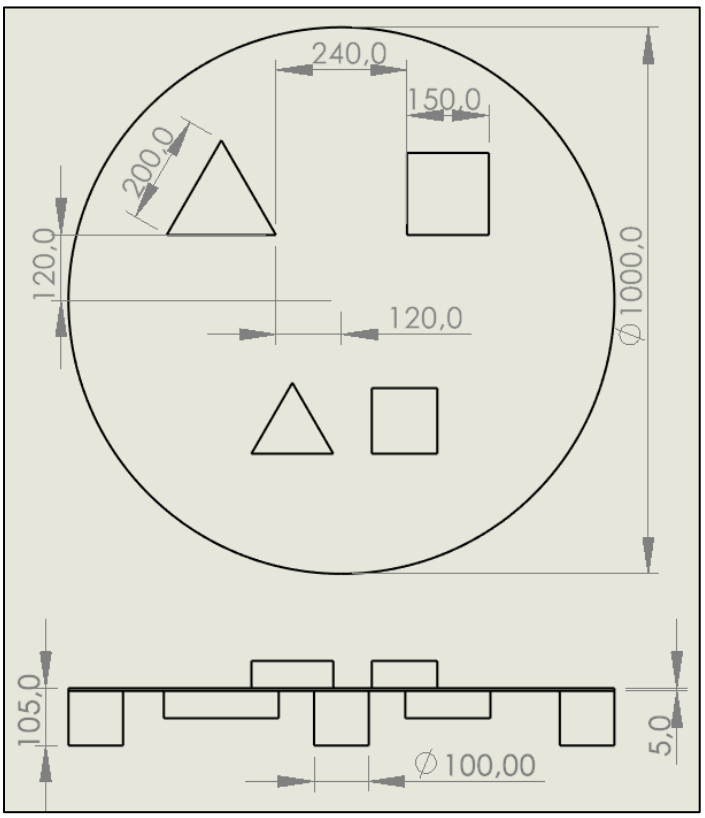

Figure 3.7: *Platform technical drawing (in millimeters)*

The heights of the equilateral triangle and rectangular prisms, which are expected to be passed through the gaps on the platform, are 50 mm. The dimensions of the task objects are provided in Table 3.1 below.

Table 3.1: *Dimensions of the equilateral triangle and rectangular prism objects*

Object	Top Surface Edge Length	Height (mm)
Equilateral Triangle Prism	Equilateral triangle side length 150 mm	50
Square Prism	Square side length 120 mm	50

A brushless direct current (BLDC) motor will be used to create artificial current. The height of the motor propeller center from the pool floor will be 250 mm (±30 mm) and is shown in Figure 3.9. The motor propeller will be positioned to face the center of the object placement platform, and its distance from the table diameter will be 800 mm (±50 mm), as shown in Figure 3.10. An image of the setup for creating artificial current is shared in Figure 3.8.

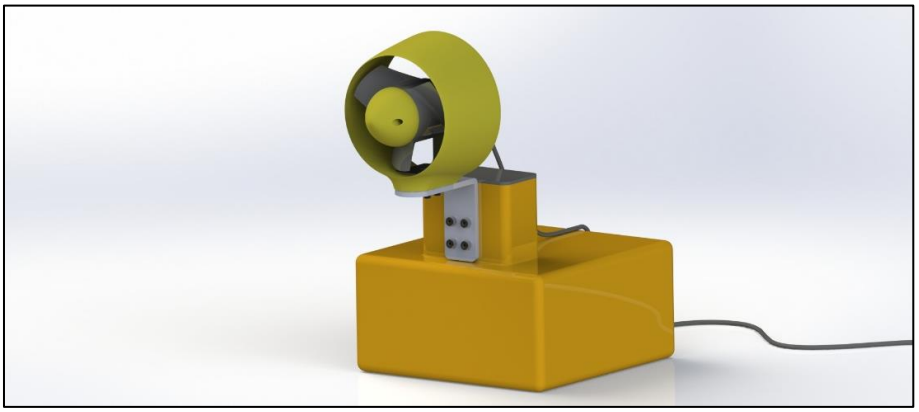

Figure 3.8: *Artificial Current Motor Platform*

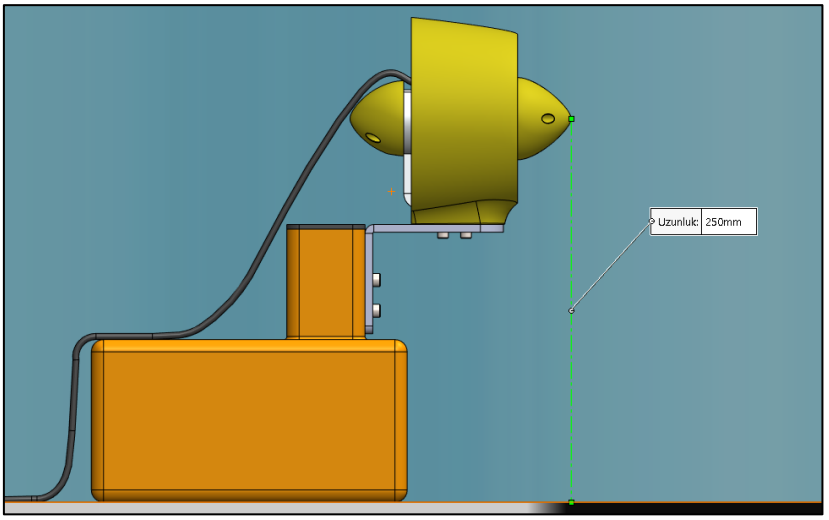

Figure 3. 9: *Height of the motor propeller center from the pool floor*

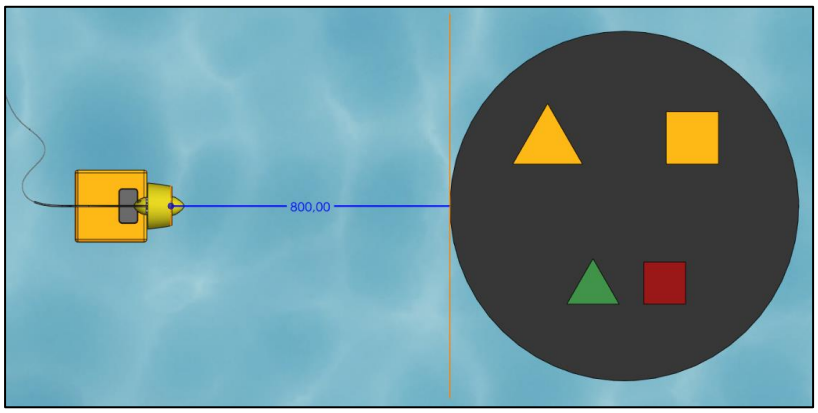

Figure 3. 10: Distance of the motor propeller from the object placement platform

In this task, the competing team's robot is expected to place the triangular prism object into the triangular gap and the square prism object into the square gap, despite the artificial underwater current. Successfully placing each object into the correct gap, despite the artificial underwater current, will add 15 points to the team's score. However, if the artificial underwater current motor platform is displaced by the team's underwater robot, even if the objects are placed in the correct gaps, no points will be added. If the underwater robot tips over the platform or moves the artificial current motor from its place, 5 points will be deducted from the team's score. Not completing this task does not prevent teams from reaching the finish line and completing the competition.

2.1.4. Task of Collecting Unwanted Objects Underwater

In this task, the competitors' underwater robots will perform the task of collecting objects that are considered to negatively affect underwater life, within an area symbolically surrounded by illuminated buoys. The visual for the task is shown in Figure 3.11. The height of the illuminated buoys from the ground, as seen in Figure 3.11, will be 600 mm.

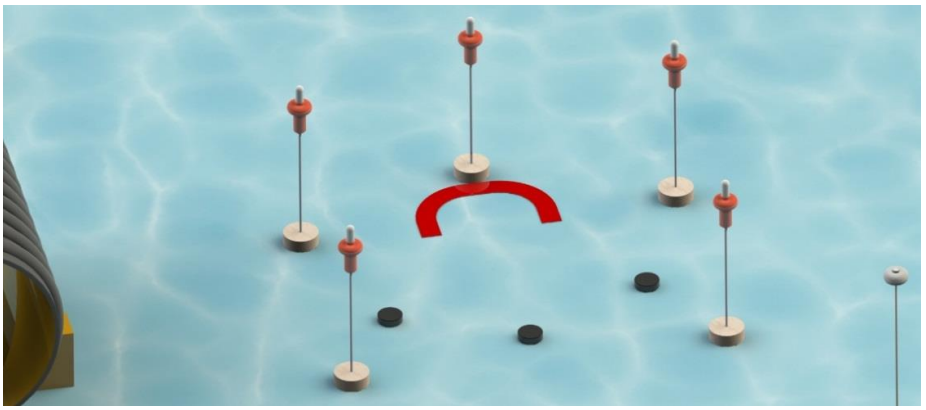

Figure 3.11: *Ring Transport Task*

The unwanted objects underwater will be identical black cylinders with a diameter of 100 mm and a height of 30 mm. The technical drawing of one of these cylinders is shown in Figure 3.12.

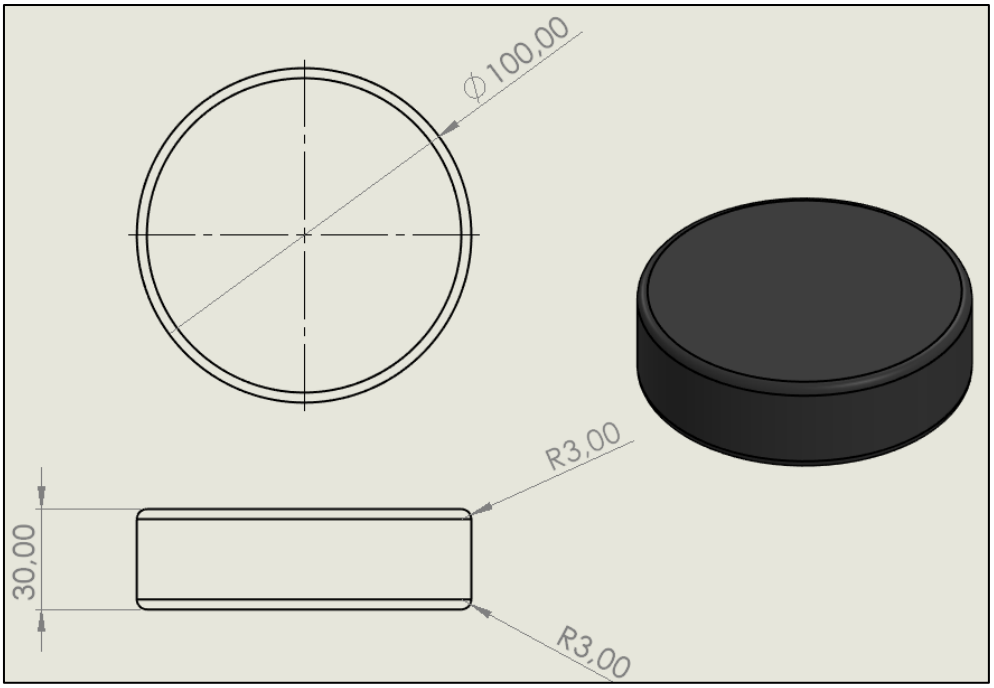

Figure 3. 12: *Technical drawing of the cylinder object to be collected (in millimeters)*

The black cylinders will be collected from their location by dragging or carrying methods into a red-colored area resembling the letter "U," as shown in the technical drawing in Figure 3.13.

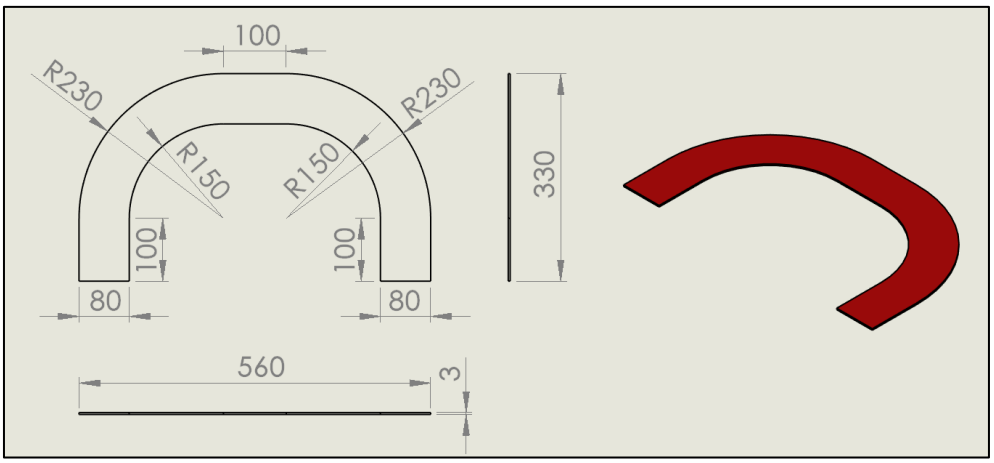

Figure 3. 13: *Technical drawing of the 'U' shaped black cylinder collection area (in millimeters)*

The black cylinders will be randomly placed on the pool floor by the referees. The corners of this placement area will be surrounded by illuminated buoys. The distance between the centers of the illuminated buoys, when viewed from above, will be 1000 mm (±50 mm) in the vertical

direction and 1500 mm (±50 mm) in the horizontal direction, and will be placed by the referees. The technical drawing of the placement plan is shown in Figure 3.14.

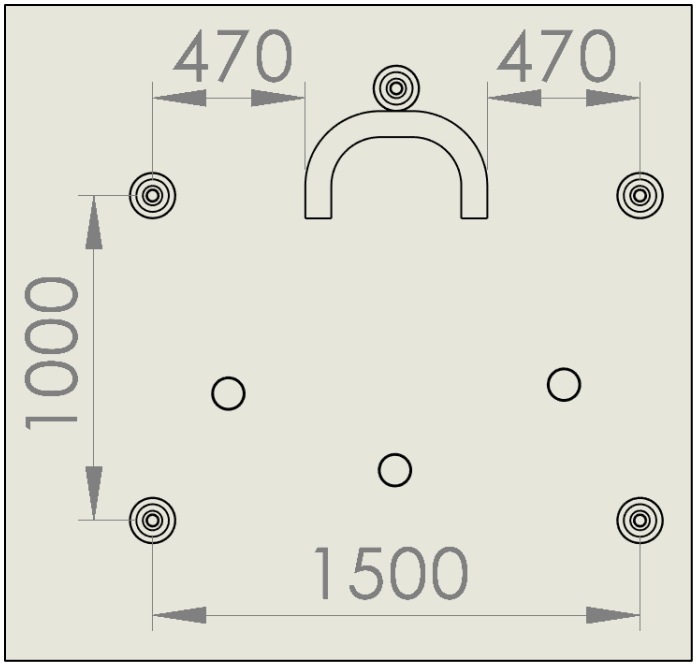

Figure 3. 14: *Technical drawing of the black cylinder collection task placement plan (in millimeters)*

In this task, if the robot places each black cylinder into the red-colored area resembling the letter 'U,' 10 points will be added to the team's score. If the underwater robot displaces the 'U' shaped collection area platform placed on the floor, 5 points will be deducted from the team's score. It is the teams' responsibility to avoid maneuvers that cause the robots to get caught on the illuminated buoys. In this case, the competition time will not be stopped. Team members are expected to move in coordination to prevent this situation from occurring.

2.1.5. Artificial Reef Creation Task

Artificial reefs are constructed using man-made hard materials to preserve underwater biodiversity, develop and rehabilitate marine life in areas that have lost their biological characteristics. In this task, the competitors are expected to successfully build an artificial reef. The visual for the artificial reef creation task is shown in Figure 3.15.

In the artificial reef creation task shown in Figure 3.15, competing teams are expected to place three different-sized and shaped task objects onto three platforms of different heights, resembling tables. There are no requirements for the order or size of the placement. During the

competition, the vehicle operator will be able to place the desired object onto the platform of their chosen height in any order they prefer.

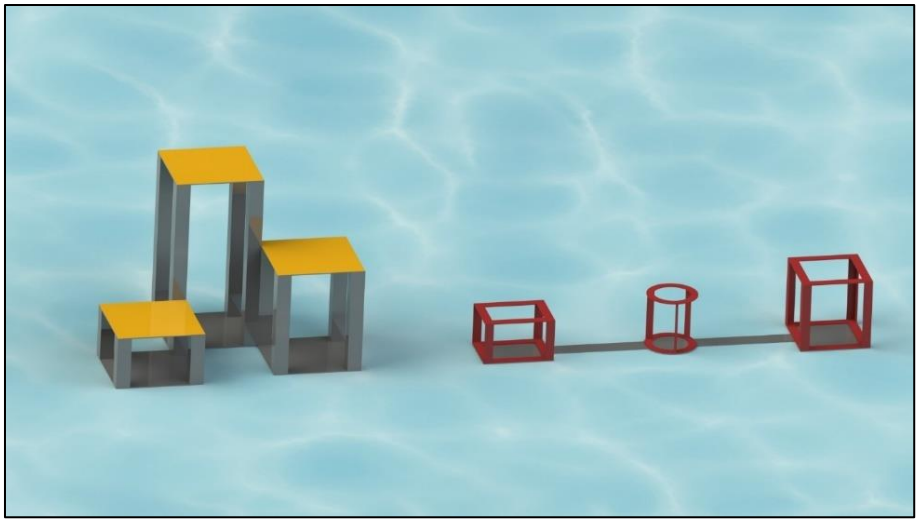

Figure 3. 15: *Artificial reef creation task objects*

The technical drawings of the objects to be carried and placed on the platforms to create the artificial reef are shared in Figures 3.16, 3.17, and 3.18.

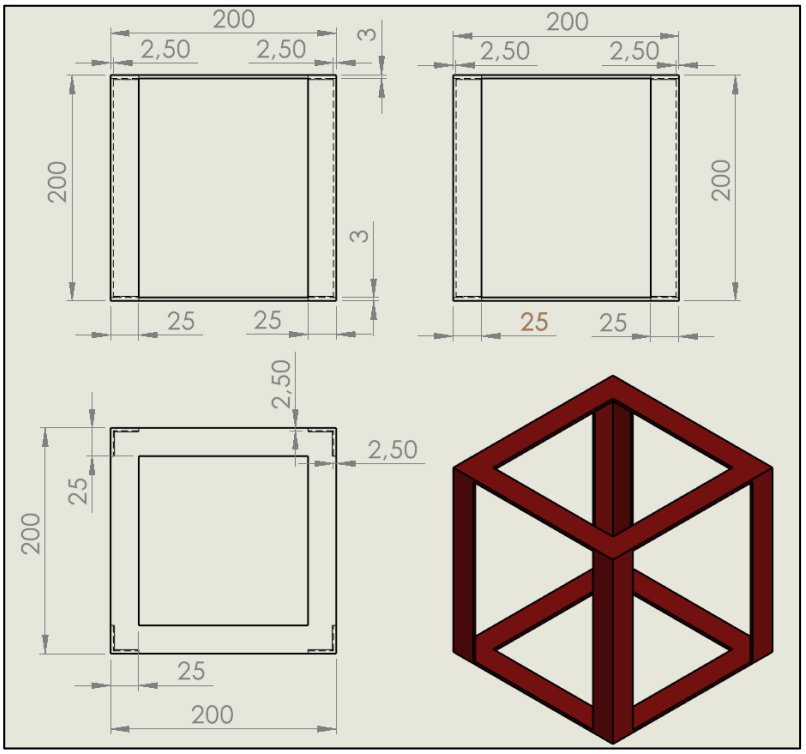

Figure 3. 16: Technical drawing of the hollow cube artificial reef object (in millimeters)

In Figure 3.16, the hollow cube object created has a base and top thickness of 3 mm, and the column structures are drawn as angle brackets with a width of 25 mm x 25 mm and a thickness

of 2.50 mm. In Figure 3.17, the hollow cylinder created has a base and top thickness of 3 mm, and the column structures are drawn with a width of 20 mm and a thickness of 2.50 mm.

In Figure 3.18, the hollow rectangular prism created has a base and top thickness of 3 mm, and the column structures are drawn with a width of 20 mm and a thickness of 2.50 mm.

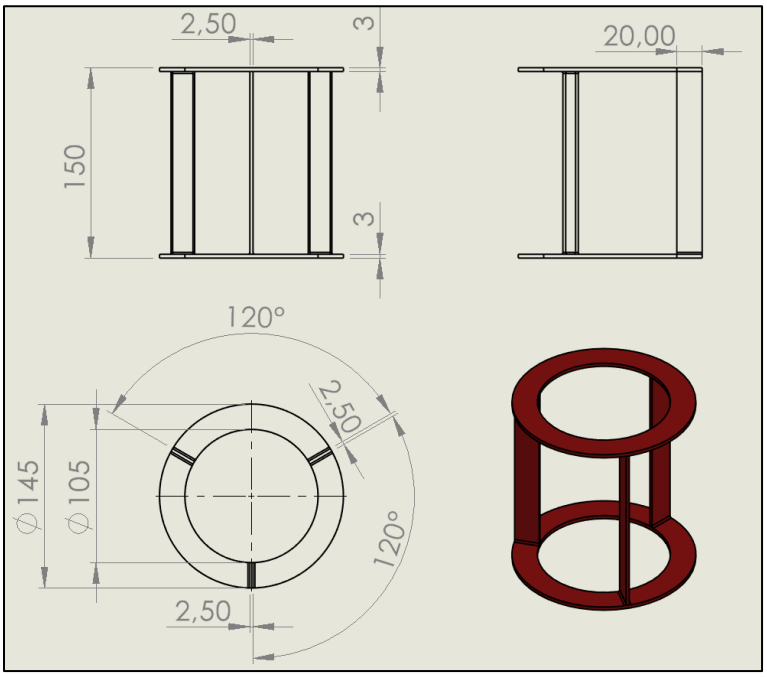

Figure 3. 17: *Technical drawing of the hollow cylinder artificial reef object (in millimeters)*

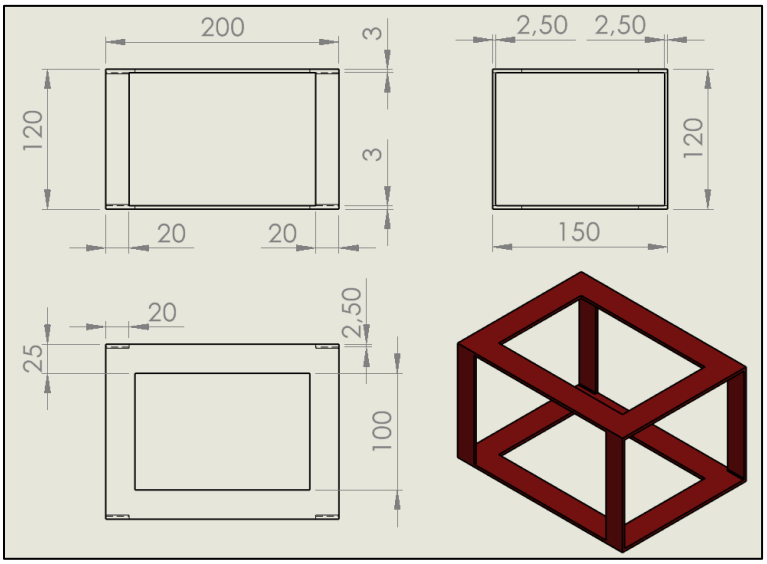

Figure 3. 18: *Technical drawing of the hollow rectangular prism artificial reef object (in millimeters)*

In the artificial reef creation task, the platforms on which the underwater robots will carry and place the objects shown in Figures 3.16, 3.17, and 3.18 are shown in Figure 3.19.

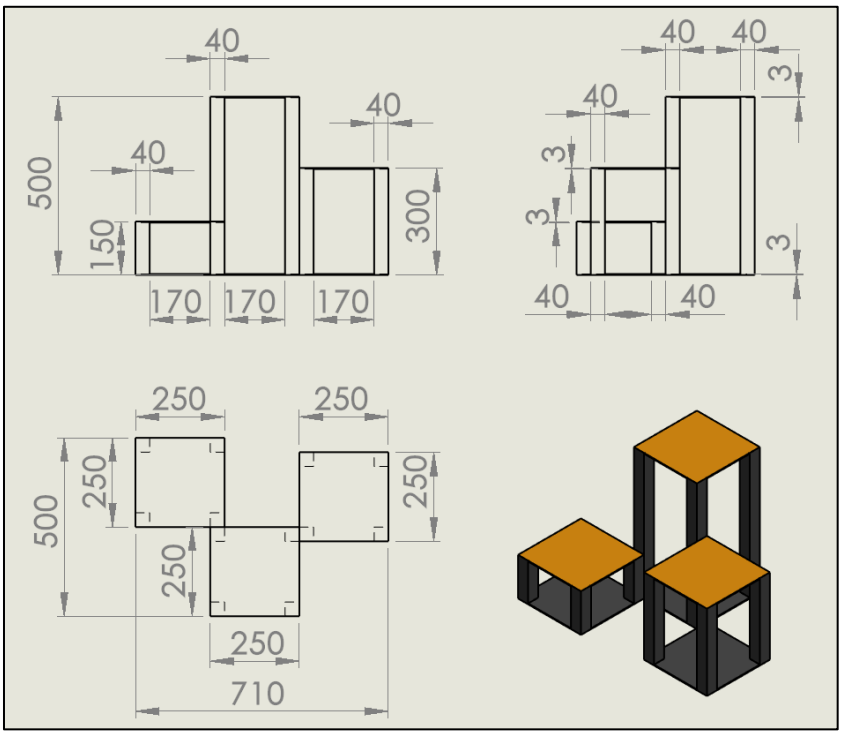

Figure 3. 19: *Technical drawing of the platform where the artificial reef creation objects will be placed (in millimeters)*

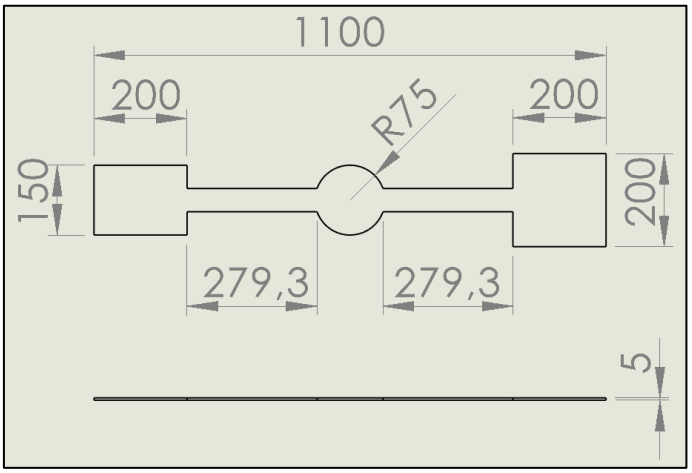

Figure 3. 20: *Technical drawing of the ground platform for positioning the reef creation objects (cube, cylinder, and rectangular prism) (in millimeters)*

In the view shown in Figure 3.19, the artificial reef objects shown in Figures 3.16, 3.17, and 3.18 will be carried and placed on platforms with three different heights, resembling tables, on 250mm x 250mm surfaces. For each object placed, regardless of the order, 10 points will be added to the team's score. If any or all of the platforms, resembling tables with three different heights shown in Figure 3.19, are displaced or tipped over by the underwater robot, 5 points will be deducted from the team's score.

In the artificial reef creation task, the artificial reef objects shown in Figures 3.16, 3.17, and 3.18 will be placed on the platform shown in Figure 3.20, according to their dimensions, on the surface. The purpose of placing this platform on the floor is to position artificial reef objects at the same distances for each competitor. If the platform shown in Figure 3.20, which holds the objects, is moved by the underwater robot trying to carry and transport the objects, 5 points will be deducted from the robot's team score.

2.1.6. Competition Course Layout Plan

The objects for the tasks in the competition course will be placed by the referees according to the technical drawings. The layout plan may be modified by the referees to ensure the overall integrity of the competition is maintained, based on the dimensions of the pool. The planned task object layout plan is shown in Figure 3.21. The dimensions in this layout plan will be placed with a margin of error of ±100 mm, considering the difficulty of placing objects underwater. The referees will ensure that all competitors race under the same conditions according to the prepared competition course layout plan. If any competing teams change the positions of the objects, the referees will place them back within the allowed margin of error. The table referee will monitor this situation through cameras.

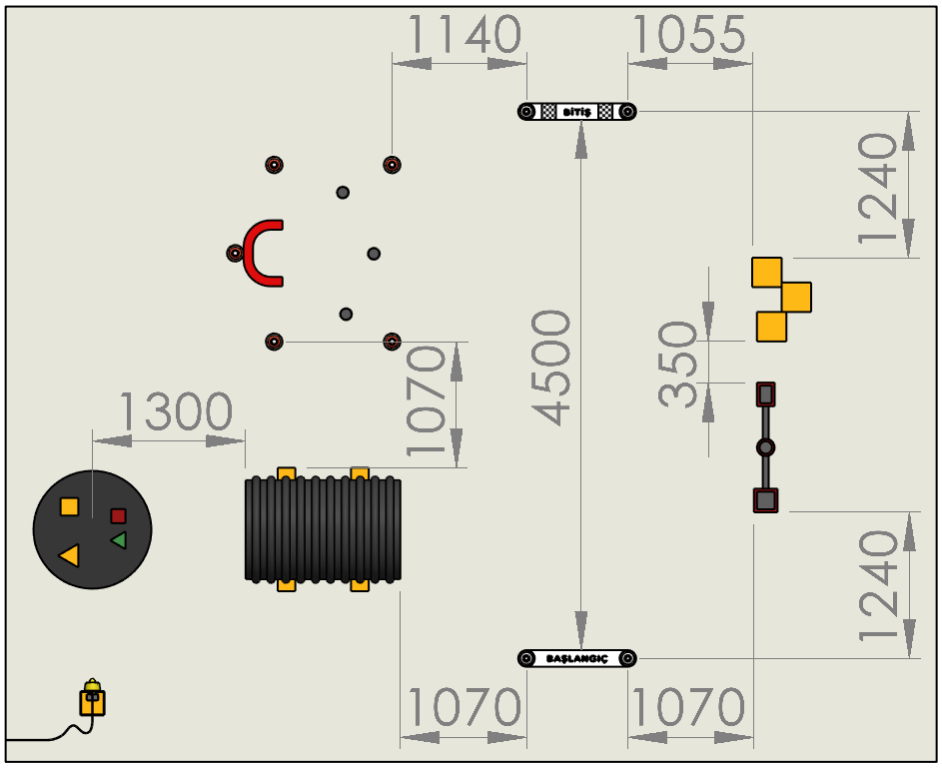

Figure 3. 21: *Competition course layout plan (in millimeters)*

2.2. Preliminary Selection Process

2.2.1. Robot Production Report

In the International MEB Robotics Competition Underwater Robots (SAR) category, 50 teams will be invited to compete. In selecting the competitors, technical information such as "Materials used in robot production," "Robot production process," "Programming language used for the robot," and "Budget used for the robot production" under the subheading of "Robot Production Report," along with a video demonstrating the underwater robot's mobility and photos taken from different angles showing the robot's construction stages, will be decisive. The "Robot Production Reports" will be uploaded to the Production Report attachment page and evaluated as specified in the general Application Guide of the 17th International MEB Robotics Competition.

2.2.2. Underwater Robot Movement Video

In determining the competitors, the applying teams should consider the criteria in the Production Report Guide when adding videos and images. The video demonstrating the robot's mobility, provided as a URL, must be at least two minutes and no more than three minutes long. The beginning of the video must show the robot's waterproof status. After the video starts, the underwater robot must be submerged and held steady within the camera's view for 30 seconds.

After the 30 seconds of the waterproof test, the robot must dive down at least half of its height and move at least one meter forward. Then, at the driver's request, the robot should make a 90-degree turn to the right or left and move forward at least 50 cm. From this point, it should stop, turn 180 degrees, and be able to return to the water surface following the same path back to the point where it first dived..

2.3. Rules

- Teams must submit all objections according to the general rules outlined in the "**Application Guide**".
- For questions related to the competition, participants must log into the International MEB Robotics Competition system at robot.meb.gov.tr, and select the "Underwater

Robots (SAR)" category from the information menu. Questions outside the category messages will not be answered. Objections regarding this will not be accepted.

- In the International MEB Robotics Competition Underwater Robots (SAR) category, 50 teams will be invited to participate. The selection of participants will be based on technical information such as "Materials used in robot production," "Robot production process," "Programming language used for the robot," and "Budget used for robot production," along with a video demonstrating the underwater robot's mobility and photos showing different angles of the robot's construction stages. The "Robot Production Reports" will be uploaded to the Production Report attachment page and evaluated as specified in the general Application Guide of the 17th International MEB Robotics Competition. The video demonstrating the robot's mobility must be at least two minutes and no more than three minutes long. Teams must adhere to the criteria outlined in the Production Report Guide when adding videos and images. The tasks expected to be performed and the evaluation criteria for these tasks are explained in the "3.2. Preliminary Selection Process" section of this guide. The team score will be determined based on the Robot Production Report. The top 50 teams will qualify to compete in the 17th International MEB Robotics Competition Underwater Robots (SAR) category..
- Teams can consist of a maximum of two members: one robot control member (driver) and one assistant member. The assistant team member may assist with verbal guidance and controlling the robot's cable. If any of the two members fail to attend the competition area, no additional member will be allowed. In this case, the team will continue with only one member. During the competition, role switching between the assistant member and the driver is allowed.
- The competition ranking for teams will be determined by a draw according to the conditions outlined in the Application Guide and will be announced before the competition. Teams cannot object to the competition order. The team whose turn it is must be present in the competition area.

- In case a team has competition assignments in another category at the same time, the responsibility lies with the team. No precaution will be taken for this situation. Teams must begin their competition at the time determined by the draw.
- The provision of any materials and equipment needed for the tasks will be the team's responsibility.
- If cables or equipment of the underwater robots become tangled or attached to a task object, resulting in the failure to complete the task under the specified conditions, no points will be awarded for the task. Teams are responsible for taking preventive measures to avoid such situations. Objections due to this situation will not be accepted.
- If the cables or equipment of the underwater robots become tangled or attached to a task object, the robot driver is expected to resolve the situation through the robot's mobility. If the driver is unable to resolve this, they may choose to withdraw.
- The desk referee will watch live footage from the underwater cameras. They will share any unseen situations with the poolside referees and ensure that the competition is conducted according to the specified rules. The live footage viewed by the desk referee will be shared on a television screen. Objections to the viewing of this footage by spectators or competitors will not be accepted.
- Not completing any task does not prevent teams from completing other tasks. The order of tasks is based on the strategy developed by the teams for the competition.
- Each team will be given 5 minutes for preparation. After 5 minutes, the competition time will start. If the team is ready before the preparation time is over and informs the referee that they are ready, the competition will start with the referee’s command.

- The total competition time is **10 minutes**. At the end of this time, teams must remove their robot from the pool, regardless of whether the robot has passed the finish platform or not. The task points earned by the teams at the end of the competition will be added to their total score.

- Competing teams will be ranked based on their total points in descending order. If two teams have the same points, their ranking will be determined by the time recorded on the chronometer at the finish platform. The team with the shorter completion time will be ranked higher. If two teams with equal points have also withdrawn, the team that withdrew will be ranked lower. If both teams with equal points have withdrawn, their ranking will be determined by the weight of their robots, with the lighter robot ranked higher.
- Completing the tasks and passing the finish platform before the total competition time will determine the completion time. The total team points and competition completion time will affect the competition ranking.
- Competing teams can withdraw from the competition at any time. The withdrawal decision must be communicated to the referee at the poolside by the driver. Tasks performed after the withdrawal decision will not be added to the team's score, and the tasks completed before the decision will be included in the total score. The withdrawal time for these teams will be recorded as the total competition time of 10 minutes.
- Teams that pass the finish platform before the total competition time (10 minutes) will not receive points for any tasks.
- When a team is called to the competition and enters the competition area, the entry of team advisors into the area is prohibited. If an advisor persists in entering, their team will be disqualified.
- Object displacement or overturn penalties will be given once for each task. After a penalty is applied, no further penalties will be given for additional contacts with the same task. If the robot's contact with the task object renders the task unachievable, objections to obtaining points for that task will not be accepted.
- If the cables of robots controlled from outside the pool are manipulated by any team member to guide the robot, the competition time will be stopped, and the robot will be removed from the pool. **50 points will be deducted from the team's score**. Tasks completed before this incident will be added to the team's total score. If cable

manipulation is later detected from the camera footage, points for subsequent tasks will be deducted, and 50 points will be deducted from the team's score.

2.4. Team Score Calculation

2.4.1. Scoring Table:

Tasks	Competition Points
Passing through the Pipe Task	1 x 10 Points
Placing Object Underwater Task	2 x 15 Points
Collecting Unwanted Objects Underwater Task	3 x 10 Points
Artificial Reef Creation Task	3 x 10 Points
Maximum Possible Task Points	100 Points

2.4.2. Penalty Points:

- If the underwater robot moves the pipe platform supported by wedges (Figure 3.5), **5 points will be deducted from the team score.**
- In the underwater current object placement task, if the underwater robot knocks over the platform resembling a table that carries objects (Figure 3.6) or moves the artificial current motor**, 5 points will be deducted from the team score**.
- If the underwater robot moves the artificial current-generating motor platform (Figure 3.9) and prevents the task from being performed under the required conditions, **5 points will be deducted from the team score.**
- If the underwater robot moves the "U" shaped collection area platform (Figure 3.13) placed on the ground, **5 points will be deducted from the team score**.
- In the artificial reef creation task, if one or all of the platforms (Figure 3.19), which resemble tables and have three different heights for the task objects to be moved onto, are moved or knocked over by the underwater robot, **5 points will be deducted from the team score.**

- If the platform under the objects to be moved for the artificial reef creation task (Figure 3.20) is moved by the underwater robot while attempting to hold and transport objects, **5 points will be deducted from the team score.**
- If any team member interferes with the cable controlling the vehicle from outside the pool and directs the vehicle, resulting in a violation detected by the referees, **50 points will be deducted from the team.**

Total Team Score = Task Points – Penalty Points

2.5. Competition Area and Workspace Details

The competition area will be supplied with 220 VAC power. Additionally, there will be a control table near the competition pool where the team whose turn it is can control their underwater vehicle. The teams will be supplied with 220 V AC voltage here. The maximum DC or AC voltage level that can be used in the designed underwater robot will be 50 V. (There are no current or capacity limits).

2.6. Underwater Vehicle Technical Specifications, Safety, and Restrictions

- The cable used by the underwater vehicles for energy, data, and control transmission should be at least 20 meters long for smooth task execution in the competition track.
- The underwater vehicle **can be controlled with or without a camera.** During the competition, drivers will be able to see the condition of the vehicle inside the pool.
- Underwater vehicles must be water-resistant to a depth of 2 meters.
- Cables used in underwater vehicles must be insulated by the teams to prevent wear and electrical leakage.
- The cable used in the underwater vehicle **should be equipped with buoyant equipment** (buoys, foam, etc.) at certain intervals to prevent it from getting tangled with task objects. Any cable tangling or getting caught on a task object is the responsibility of the competitors, and objections regarding this will be **considered invalid.**
- Before the competition, the safety of the underwater vehicles will be checked by the referees. Robots deemed unsuitable will not be allowed to compete.

- **No 220 V AC power will be allowed to be transmitted to the vehicle and/or pool for safety reasons.**
- Before the competition, robots will undergo a waterproofing test with the power off, and if any team's robot is found to have water leakage during the competition or preparation period, they will **be disqualified.**
- After the necessary checks, energy can be supplied to the vehicles.
- Battery-powered vehicles **must have an easily accessible emergency stop button**, which should cut off the power and stop the motors. There are no restrictions on the type of stop mechanism (magnetic, push-button, etc.).
- **Battery-powered vehicles must operate with a maximum of 50V DC voltage and must not exceed this limit.**
- Any battery may be used. There are no limits on current or capacity.
- Batteries must be transported in a fireproof protective bag. If the battery is embedded within the vehicle and cannot be removed, the vehicle's power must be cut off before transporting it.
- Vehicles powered externally will be supplied with a maximum of 50V.
- This supply voltage will be provided by the teams' own AC/DC converters.
- Vehicles powered from external sources **must have an emergency stop button**.
- The cables powering external vehicles must be insulated for water and environmental protection, and no cables should be exposed. The power source or cable must be equipped with fuses according to the determined voltage and current.
- The motors of the underwater vehicle must be insulated against water and should be capable of operating underwater.
- The vehicle's body and motor propeller sections must not have sharp edges or points, and any unsuitable parts must be rounded or dulled.
- Motor propellers **must not be exposed**. They **must be isolated with a protective outer shell.**

- The vehicle's attached cables should not be taut and must be resistant to sudden movements.
- Changes in the pool dimensions may lead to changes in the track or task object measurements without affecting the overall structure.
- Objections made during the competition regarding issues caused by light and sound will be **considered invalid**. The Competition Organization Committee reserves the **right to change the rules if necessary.**
- Hydraulic systems and any oil used in the vehicle compartment are **prohibited,** as they could negatively affect the continuation of the competition in case of leakage.
- **No chemicals should be allowed to mix with the pool water**. Vehicles must be designed with this **consideration in mind.**

2.7. ETHICAL RULES

- Avoid rude and impolite words and behavior.
- Refrain from insults, threats, and offensive language.
- Avoid direct insults via email, Facebook, Skype, Messenger, WhatsApp, Twitter, YouTube, etc.
- Pay attention to spelling rules and tone in petitions and objections.
- Do not engage in actions, words, or behavior that affect the functioning or motivation of other teams in the competition area.