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1. **Outline of the Contest**

Each team consists of no more than three robots: one manual and one or two automatic robots. The manual robot must complete the first task by picking up three Joss Stick Pots and placing them at Common Zone before performing other tasks. After that, the manual robot will bring a Candle Base and place it at Decoration Point located on Sala. The manual robot will collect Joss Sticks from the Common Zone to be used again during Krathong assembly.

The automatic robots will collect Krathong Petals and Flowers and place them at Preparation Points. The automatic robots will decorate Krathong by stacking one Krathong Petal and then one Flower on the Candle Base located on Sala. After completing this task, the manual robot will then place three Joss Sticks into the decorated Krathong. The automatic robots will carry the completed Krathong and drop it on River Surface of its own side. No part of any robots can touch or contact the River Surface.

Lastly, only one of the automatic robots will bring and drop a Candle Light Flame on top of the Candle in the completed Krathong floating on the River Surface. No part of any robots can touch or contact the River Surface or the completed Krathong. The first team that drops the Candle Light Flame successfully is the winner of the match. This type of winning is called "Loy Krathong".

If neither team achieves the "Loy Krathong" within 3 minutes, the winner shall be decided by the earning scores of the completed tasks.

Each match is contested by **Red** and **Blue** teams. A match lasts 3 minutes.

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2. Game Field: Structure and Specifications

1. The field consists of a Game Area having the dimension of 12,000 mm x 12,000 mm and surrounded by a wooden fence with a height of 100 mm and a thickness of 50 mm. The game field is divided equally for two teams by a wooden fence with a height of 100 mm and a thickness of 50 mm. The competing teams are Red and Blue teams. (Figures 1-4)

2. White lines with a width of 30 mm made of non shiny sticker are drawn on the floor of the Game Area.

3. The Game Area consists of a Common Zone, a Sala, a River Surface, Start Zones, Preparation Points and Storage Points.

1. Common Zone has a rectangular shape with a width of 500 mm and a length of 3,500 mm painted in light green color. Six Poles are located at the middle line of the Common Zone for placing Joss Stick Pots. The gap between the Poles is 500 mm. Each team can collect at most of nine Joss Sticks from the Common Zone for Krathong assembly.

2. Sala is a lifted up platform with a height of 300 mm, a width of 4,000 mm and a length of 5,000 mm. It is divided equally for Red and Blue teams. Each part consists of a Decoration Point, a circular shape with a diameter of 510 mm surrounded by a wooden fence with a height of 10 mm and a thickness of 10 mm. Two ramps each with a length of 1,000 mm are built at two sides of the Sala to facilitate the automatic robots for moving up. (Figures 5-6)

3. River Surface is located in the middle of the Sala. It can be swung by Krathong gravity during dropping. (Figure 7)

1. River Surface is a platform made of wood with a thickness of 4 mm, a width of 700 mm, a length of 2,400 mm. It is suspended at a level of 280 mm measured from the Sala to the lower surface of the platform by four wires made of stainless steel each with a diameter of 1.5 mm and a length of 350 mm. All parts and mechanisms which form the River Surface are considered as River Surface. They cannot be locked or touched by any robots.

2. River Bank is made of a wooden fence with a height of 180 mm from Sala and a thickness of 10 mm. There are 4 sides surrounding the River Surface. The River Bank can be painted or decorated to represent water or river. (Figures 8-9)

3. Each team has 3 Start Zones: two Automatic Start Zones, one Manual Start Zone. Each Start Zone is a square with a length of 1,000 mm each side. Start Zones of Red team are in red color, Start Zones of Blue team are in blue color.

4. Storage Points and Preparation Points made of wood, steel, or other rigid metal are Poles used to store or place some contest tools. Each Pole of the Storage Points and Preparation Points consists of two sections; lower and upper sections. The lower section has a cylindrical shape with a diameter of 100 mm and a height of 800 mm. The upper section has a total height of 100 mm. Top part of the upper section has a conical shape with the diameter varying from 40 mm measured at the topmost position until 60 mm measured at the distance of 30 mm from the topmost position. The bottom part of the upper section has a cylindrical shape with a diameter of 60 mm. However the upper section of each Pole of the Storage Points of Candle Light Flame has only a cylindrical shape with a diameter of 60 mm and a height of 35 mm. (Figures 10-12)

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5. Specifications of Krathong and Other Contest Tools

1. Candle Bases, Krathong Petals, Flowers, Joss Sticks, Joss Stick Pots, Candle Light Flames used in the contest are provided by the organizer. (Figures 14-19)

1. The weight of a Candle Base is approximately 800 g.
2. The weight of a Krathong Petal is approximately 250 g.
3. The weight of a Flower is approximately 250 g.
4. The weight of a Joss Stick is approximately 100 g.
5. The weight of a Candle Light Flame is approximately 200 g.

6. The total weight of the completed Krathong is approximately 1,700 g. (Figure 13)

7. Upper Surface of the Candle Base, the Krathong Petal, the Flower or the Joss Stick Pot is made of rubber, plastic or cardboard paper cut in a doughnut shape with a thickness of 3 mm. Color of the Upper Surface is pink for the Red team and sky blue for the Blue team.

8. Lower Surface of the Krathong Petal, the Flower or the Joss Stick Pot is made of rubber, plastic or cardboard paper cut in a doughnut shape with a thickness of 3 mm. Color of the Lower Surface is pink for the Red team and sky blue for the Blue team.

9. Krathong consists of a Candle Base, a Krathong Petal and a Flower. The detail of each part is explained as follows:

1. Candle Base consists of four parts (Figure 14):

1. Base is made of wood or plastic with a thickness of 4 mm cut in circular shape with a diameter of 500 mm.

2. Cylindrical Foam glued with the Base has an inner diameter of 70 mm and an outer diameter of 500 mm and a height of 100 mm.

3. Upper Surface covers the top of the Cylindrical Foam.

4. Candle fixed to the Base is made of a hollow plastic or wooden pipe with a height of 503 mm measured from the Base and a diameter of 60 mm.

Top end of the Candle is closed with a circular plate made of rubber, wood, plastic or cardboard paper with a thickness of 4 mm and half black and half white pattern. Bottom end of the Candle is inserted into a plastic cap with an outer diameter of 70 mm and a height of 70 mm and a thickness of 5 mm. The cap is fixed to the Base by screws.

5. Krathong Petal is made of a cylindrical foam with an inner diameter of 76 mm and an outer diameter of 400 mm and a height of 100 mm. A hollow plastic tube with an outer diameter of 76 mm and a thickness of 2 mm and a height of 100 mm is fixed at the center of the foam to facilitate insertion. Top surface of the Krathong Petal is covered with the Upper Surface and decorated with four petals. Bottom surface of the Krathong Petal is covered with the Lower Surface. (Figure 15)

6. Flower made of a cylindrical foam has an inner diameter of 76 mm and an outer diameter of 280 mm and a height of 100 mm. A hollow plastic tube with an outer diameter of 76 mm and a thickness of 2 mm and a height of 100 mm is fixed at the center of the foam to facilitate insertion. Three holes for placing Joss Sticks each locating 85 mm from the center of the Flower with 120 degree apart are made on the Flower. Each hole has an inside diameter of 42 mm. A hollow plastic tube with an outer diameter of 42 mm and a thickness of 2 mm and a height of 100 mm is fixed at the center of each Joss Stick hole to facilitate insertion. Top surface of the Flower is covered with Upper Surface. Each team is encouraged to decorate this Upper Surface with flowers. The decorated flowers can only be used for decoration purpose and cannot be used strategically for the contest. Bottom surface of the Flower is covered with the Lower Surface. (Figure 16)

7. Joss Stick is made of a hollow plastic or wooden pipe with a height of 250 mm and a diameter of 34 mm. Both ends of the Joss Stick are closed with circular plates made of rubber, wood, plastic or cardboard paper each with a thickness of 3 mm. Top part of the Joss Stick is painted in Red for Red team and Blue for Blue team with a height of 50 mm. (Figure 17)

8. Joss Stick Pot is made of a cylindrical foam with an inner diameter of 76 mm and an outer diameter of 280 mm and a height of 100 mm. A hollow plastic tube with an outer diameter of 76 mm and a thickness of 2 mm and a height of 100 mm is fixed at the center of the foam to facilitate insertion. Three holes for placing Joss Sticks each locating 85 mm from the center of the Joss Stick Pot with 120 degree apart are made on Joss Stick Pot. Each hole has an inside diameter of 42 mm. A hollow plastic tube with an outer diameter of 42 mm and a thickness of 2 mm and a height of 100 mm is fixed at the center of each Joss Stick hole to facilitate insertion. Top surface of the Joss Stick Pot is covered with the Upper Surface. Bottom surface of the Joss Stick Pot is covered with the Lower Surface. Its weight is approximately 250 g. (Figure 18)

9. Candle Light Flame consists of two sections (Figure 19):

1. Base is a cap in cylindrical shape made of a hollow plastic tube with an outer diameter of

76 mm and a height of 55 mm and a thickness of 2 mm. Top end of the plastic tube is closed with a circular plate made of plastic with a thickness of 3 mm.

2. Flame is formed by foam, plastic, rubber, paper or fiberglass in conical shape with a height of 100 mm.

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3. Game Procedure

1. Length of a game

1. Each match lasts three minutes at most.
2. In any of the following cases, the match ends immediately (even before three minutes).
 1. When "Loy Krathong" is achieved.
 2. Disqualification is announced in the game.
 3. When the referee judges that the game cannot continue.

4. Settings of robots

1. One minute is given for setting of robots before the game starts.
2. At most three members of each team can engage in setting of robots.
3. Any teams that fail to complete setting of the robots within one minute can resume the setting again once the game starts.

4. Deployment of the robots and team members at the start of the game

1. Manual Robot must be started in Manual Start Zone.
2. Automatic Robot 1 must be started in Automatic 1 Start Zone.
3. Automatic Robot 2 must be started in Automatic 2 Start Zone.
4. After starting any automatic robots, the team members who perform the starting action must leave the game field immediately.

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5. Competition Tasks and General Restrictions

Once the game has begun, each team shall complete the tasks in the following order:

1. The Manual Robot picks up three Joss Stick Pots and places them at any Poles in the Common Zone. The three Joss Stick Pots include two Joss Stick Pots which belong to its team and one Joss Stick Pot which belongs to the other team. Without completing this task, the manual robot is not allowed to do other tasks, likewise, the automatic robots are not allowed to

start.

2. The Manual Robot brings the Candle Base and places it at the Decoration Point on the Sala.

3. The Automatic Robots collect Krathong Petals and Flowers from the Storage Points and move on the ground field only before placing them at the Preparation Points.

4. The Automatic Robots move up the Sala and bring a Krathong Petal and a Flower from the Preparation Points. The automatic robots stack a Krathong Petal on the Candle Base at the Decoration Point, and then stack a Flower on the Krathong Petal.

5. The Manual Robot collects any Joss Sticks that belong to its team which are considered from color of the Joss Sticks from the Common Zone and places three Joss Sticks at the three holes of the decorated Krathong on the Sala. During placing the Joss Sticks, the Manual Robot is allowed to touch the decorated Krathong at the Decoration Point.

6. The Automatic Robots carry the completed Krathong and drop it on the River Surface. No part of the robots is allowed to touch the River Surface either directly or indirectly.

7. Only one of the Automatic Robots brings a Candle Light Flame and drops it on top of the Candle in the completed Krathong floating on the River Surface. No part of the robot is allowed to touch the completed Krathong or the River Surface directly or indirectly. In any cases of dropping the Candle Light Flame on the Game Area, the dropped Candle Light Flame cannot be reused any further in the match.

Some restrictions are enforced in the game as follows.

8. In any cases of dropping the Candle Light Flame on the Game Area, the dropped Candle Light Flame cannot be reused any further in the match.

9. In the case of dropping the Joss Stick Pots, the Joss Sticks or the Candle Base, the Manual Robot can pick up the dropped Joss Stick Pots, the Joss Sticks or the Candle Bases if they are inside its own Game Area. The dropped Joss Stick Pots, the Joss Sticks and the Candle Bases can then be reused again.

10. The Automatic Robots can do any tasks of the Manual Robot.

11. The Manual Robot can be switched to become an Automatic Robot after placing three Joss Stick Pots at the Common Zone with permission from the referee. The switching process must be done in any Automatic Staring Zones. Once the Manual Robot is switched and become the Automatic Robot, it cannot be reversed back to become the Manual Robot again.

12. If a Krathong is not completed, no score for dropping that Krathong on the River Surface is given. Likewise, no score for dropping the Candle Light Flame on the Candle of the incompleted Krathong is given.

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13. Retries of Robots

1. A retry can be made only after the referee permission.

2. Team members are allowed to touch the robots while preparing for a retry.

3. Retries of a robot or several robots at the same time can be made as many times as necessary.

4. A retry of Manual Robot is made at Manual Start Zone only.

5. A retry of Automatic Robot is made at either Automatic 1 Start Zone or Automatic 2 Start Zone.

6. During a retry, the team can request the referee to bring the dropped Krathong Petals or Flowers back to their previous locations; back to the Storage Points or back to the Preparation Points if they are successfully placed earlier. The earned score still remains.

7. During a retry, the team can request the referee to bring the completed Krathong that was dropped on the way to the River Surface back to the Decoration Point. The earned score still remains.

8. During a retry, the team can bring all the objects which are held by the robots during asking for the retry back to the Start Zones. However the dimension in the Start Zone must follow the rule on starting the robots written in 8.5 and 8.6. Otherwise the objects will be considered as the dropped objects.

9. During carrying Joss Stick Pots to the Common Zone if the Manual Robot drops the Joss Stick Pots, the team members are allowed to bring the Joss Stick Pots back to the Storage Points of the Joss Stick Pots. In this case a retry is compulsory.

10. The Automatic Robots are not allowed to place Krathong Petals or Flowers to the Preparation Points while they are on the Sala. This action causes violation and a retry is compulsory. The Krathong Petals and Flowers which were placed to the Preparation Points by this action will be brought back to the Storage Points.

11. During dropping the completed Krathong on the River Surface, if any parts of the Automatic Robots or the Krathong held by the robots physically touch the River Surface either directly or indirectly, this action causes violation and a retry is compulsory. The team has to restart the Automatic Robots that made the violation at the Automatic Start Zones. The referee will remove the dropping Krathong out of the Game Area. That Krathong cannot be reused any further in the match.

12. During dropping the Candle Light Flame on top of the Candle in the completed Krathong floating on the River Surface, if any parts of the Automatic Robot or the Candle Light Flame held by the robot physically touch the Candle, any parts of the Krathong, or the River Surface either directly or indirectly, this action causes violation and a retry is compulsory. The team has to restart the Automatic Robot that made the violation and the other Automatic Robot that holds the Candle Light Flame, if any, at the Automatic Start Zones. The Automatic Robots that still hold the Candle Light Flames during this action are allowed to bring the Candle Light Flames to the Automatic Start Zones. However the dimension in the Automatic Start Zones must follow the rule on starting the Automatic robots written in 8.5, otherwise the Candle Light Flames must be brought back to the Storage Points of the Candle Light Flame.

13. The Automatic Robot is not allowed to hold the Candle Light Flame and the completed Krathong at the same time. This action causes violation and a retry is compulsory. The Candle Light Flame will be brought back to the Storage Point of the Candle Light Flame and the completed Krathong will be brought back to the Decoration Point.

14. Strategies premised on the use of retries are allowed.

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15. Deciding the Winner

1. The first team that an Automatic Robot successfully drops a Candle Light Flame on the

completed Krathong floating on the River Surface is the winner of the game and the match ends. This is the achievement of the game goal and so called "Loy Krathong".

2. If neither team achieves "Loy Krathong" at the end of the 3 minutes match, the winner is decided based on the earning scores. The team that earns higher score is the winner. The score of each task is described as follows:

1. Manual Robot successfully picks 3 Joss Stick Pots and places them at 3 Poles in the Common Zone. **[18 points]** (2 points for each Joss Stick)
2. Manual Robot successfully places a Candle Base at the Decoration Point. **[12 points]**
3. Automatic robots successfully collect 2 Krathong Petals and 2 Flowers and place them at 4 Preparation Points. **[40 points]**
(10 points for each object)
4. Automatic Robots successfully stack a Krathong Petal from the Preparation Point on the Candle at the Decoration Point. **[10 points]**
5. Automatic Robots successfully stack a Flower from the Preparation Point on the Krathong Petal at the Decoration Point. **[10 points]**
6. Manual robot successfully places 3 Joss Sticks into the holes of the decorated Krathong at the Decoration Point. **[30 points]**
(10 points for each Joss Stick)
7. Automatic Robots successfully drop the completed Krathong on the River Surface. **[30 points]**

8. An Automatic Robot successfully brings Candle Light Flame and drops it on top of the Candle in the completed Krathong floating on the River Surface. **[50 points]**

9. The game result

1. The game result is announced after the end of the 3 minutes match and the referee already checks and confirms the completed tasks and the faulty actions of the robots.
2. The Match will end when
 1. End of 3 minutes.
 2. One of the teams is disqualified.
 3. One of the teams achieves the goal, "Loy Krathong".
4. A total score of **300** points is given to the team that achieves "Loy Krathong".
5. Before achieving "Loy Krathong", more than one set of Krathong can be made and dropped.

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6. Cautions in Robot Design and Development

1. Each team is recommended to build 3 robots: 1 Manual Robot and 2 Automatic Robots.
2. Each robot must not be split into sub-units or connected by flexible cords.

3. Only the communication between Automatic Robots is allowed, however, wireless radio frequency is prohibited.

4. The robots in the contest must be built by the team members from the same university/college.

5. Automatic Robots

1. Each Automatic Robot must perform its tasks automatically after it is started by a team member.

2. In the Automatic Start Zone, the Automatic Robot must have its dimension no larger than 1,000 mm in width, 1,000 mm in length and 1,400 mm in height. There is no limitation on the dimensions of the Automatic Robot after the game starts.

3. Manual Robot

1. The manual robot is operated by a team member through a connected cable, an infrared remote control, visible ray or sound control. Wireless radio frequency control is prohibited. The operator is not allowed to ride on the robot.

2. In the case of operation through cable, the length of cable must be in between 1,000 mm and 3,000 mm. The cable connection on the robot must be placed at a height of no less than 1,000 mm above the floor.

3. In the Manual Start Zone, the Manual Robot must have its dimension no larger than 1,000 mm in length, 1,000 mm in width and 1,400 mm in height. The robot can expand, stretch or extend within a cylinder of 2,000 mm in diameter considered from top view.

4. Weights of the robots

1. The total weight of all robots, equipments and other devices used in the entire contest must not exceed 50 kg. However, the back-up set of batteries of the same type, weight and voltage as the primary set of batteries, is exempted.

2. Power sources of the robots

1. Each team must prepare its own power sources.
2. The voltage of the power sources used by each robot must not exceed DC24V.
3. The pressure of the compressed air power must be less than 6 bars.
4. The organizer has the right to declare and prohibit any dangerous and inappropriate power sources.

5. Safety rules

1. The use of explosives, fire or dangerous chemicals is prohibited.
2. If a laser is used, it must be of class 2 or less. In designing and preparing the laser, full care must be taken to protect all persons at the venue from harm during all procedures. In particular, the beams must be so oriented that they cannot shine into the eyes of the spectators.

3. Examination of the robots

1. Participating robots are examined prior to the test run on the day before the contest and again on the day of the contest before it begins. The team that fails the examination is not allowed to participate in the test run or contest.
2. Details of what to be examined and how will be provided at a later date.

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3. Violations

If a violation occurs, 20 points will be immediately deducted and if the violation still continues, 20 points will be deducted for every 3 seconds. Each time of deduction is considered as the number of violations. The team with three violations in a match will be disqualified. The violations are categorized as follows:

1. Any parts of any robots or the objects held by any robots move out of the game field or the space above it.
2. Any parts of any robots or the objects held by any robots enter the opposing team area or the space above it.
3. Any parts of the Manual Robot or the objects held by the Manual Robot enter the River Surface or the space above it.
4. Any parts of the Manual Robot physically touch any Automatic Robots either directly or indirectly.
5. Any parts of any robots or the objects held by the robots cause obstruction in the Common Zone.
6. The operator of the Manual Robot uses the Manual Robot to hinder or cause difficulty for the opponent team while placing Joss Stick Pots in the Common Zone.
7. Any parts of any Automatic Robots physically touch the River Surface, especially during dropping the completed Krathong, either directly or indirectly.
8. Any parts of any Automatic Robots physically touch any parts of the Krathong floating in the River Surface, especially during placing a Candle Light Flame, either directly or indirectly.
9. The Automatic Robot holds any Candle Light Flames and the completed Krathong at the same time.
10. The Automatic Robot places any Krathong Petals or Flowers to the Preparation Points while it is on the Sala.
11. Other actions that infringe on the rules without mentioning in the disqualification are considered as violations.

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12. Disqualification

A team will be disqualified if it commits any of the following actions during the match:

1. The team damages or tries to damage the field, facilities, equipments or opponent's robots.

2. The team performs any acts that are not in the spirit of fair play.
3. The team fails to obey instructions or warnings issued by the referees.
4. The team has made a false start for three times in the same match.
5. The team has made three violations in the same match.

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6. **Safety issues of the robots**

1. All robots must be designed and manufactured as to pose no danger of any kinds to any persons in the venue.
2. All robots must be designed and manufactured as to cause no damage to any robots of the opposing team or the field.

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3. **Teams**

1. Each participating country or region in the contest can be represented by one team only. Thailand, as the host country, may be represented by two teams.
2. A team consists of three students and one instructor who all belong to the same university/college. The three students of the team are entitled to participate in the match.
3. In addition, three members of pit crews can adjust the robots in the pit area and can help to carry the robots to the field, but cannot participate in the match. The members of the pit crews must be students of the same university/college as the team.
4. Participation by post-graduate students is not permitted.

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5. **Others**

1. The legitimacy of any actions not provided in this rule book will be subject to discretion of the referees.
2. The dimensions, weights, etc. of the field, facilities and equipments described in this rule book have a margin of error of plus or minus 5% unless otherwise stated. However the dimensions and weights of the robots as shown in the rule book are the maximum and cannot be tolerated.
3. All questions should be addressed to the official website of the ABU Asia-Pacific Robot Contest 2011 Bangkok, <http://www.aburobocon2011.com>
FAQ section will be provided on the site.
4. Notification of any additions and/or corrections to this rule book will be made on the official web site.
5. The referees may demand additional explanations on safety issues when the safety of a robot is deemed to be in question.

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