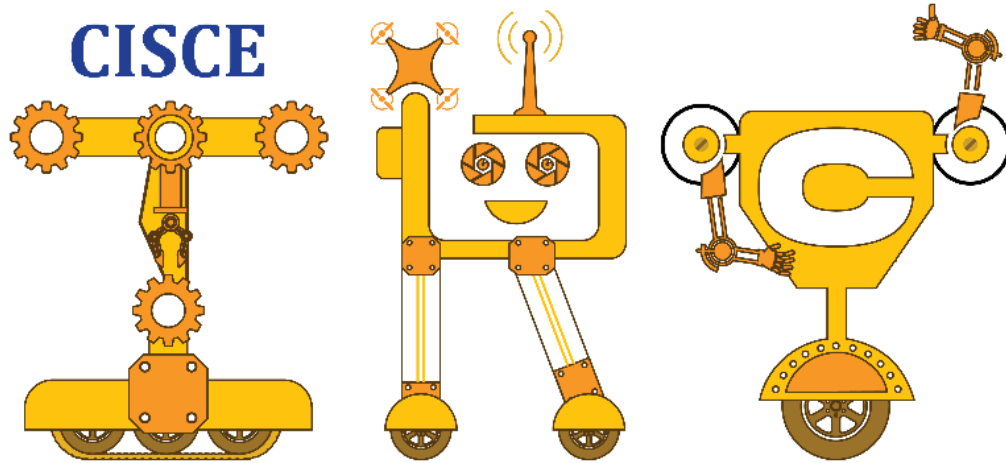




Technology
Innovation Hub
of IIT Delhi



Inter-School Robotics Championship 2024

ROBO VILLA

Game Theme and Rule Book Ver 1.0

Organized by

Council for the Indian School Certificate Examinations (CISCE)

in association with

**I-Hub Foundation for Cobotics (HFC),
Technology Innovation Hub of IIT Delhi**

July 2024

www.cisce-irc.com

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1. Theme: Industry

Construction of buildings for homes, schools and offices is an industrious task, requiring intensive time and labour to meet the world's requirements of sheltered, comfortable spaces. The advent of technology though, has enabled automation in various domains with the help of robots, including the construction industry.

This competition focuses on the use case of robots in the construction industry motivating the participants to build a robot which can help in the construction of a house.

2. Background of the Game

In the context of the game Robo Villa, the theme revolves around the construction industry. Building construction has traditionally been a labour-intensive and exhausting job for humans. However, with the advent of advanced technologies, robotics is poised to transform the construction industry. Robots can assist humans in various construction tasks, significantly reducing the physical strain on workers and increasing efficiency.

Robo Villa explores this theme by integrating robotics into the construction process. As technology continues to advance, the role of robots in helping humans build homes and other structures is expected to grow. Robots will assist in carrying bricks, planks, and other materials, making the construction process more manageable and less physically demanding for human workers. This new era of robotics in construction promises to streamline operations, enhance precision, and open up new possibilities for the industry.



Figure 1: People carrying bricks (Pic Credits: [tps://www.flickr.com](https://www.flickr.com))

3. Importance of Safety

Inter-School Robotics Championship is the platform for CISCE's students to exhibit STEM skills and also understand and practice safety regulations. Participating teams design their robot to perform the tasks as per the game ensuring the robots are safe and does not harm humans and surrounding environment and objects. Safety regulations are must to be followed by everyone in the contest, including officials, participants and spectators in all circumstances.

Safety in robots must be visible to the naked eye and the cameras. One should easily observe whether the designed robots meet the safety requirements during the video check and test runs. Please include the emergency STOP button on the robot. Team members must take care of their safety apart from the robot's safety by wearing helmets and jackets while on the play field.

4. Contest Outline

Title: Inter-School Robotics Championship 2024

Theme: Industry

Name of the Game: ROBO VILLA

Organizer: Council for the Indian School Certificate Examinations (CISCE)

Knowledge Partner: I-Hub Foundation for Cobotics (IHFC), Technology Innovation Hub of IIT Delhi

Registration Open: 15th July 2024, Monday

Final Contest Date: 11th November 2024, Monday

Final Contest Venue: Center of Excellence, Council for the Indian School Certificate Examinations Hyderabad.

Competition Stages: Preliminary, Zonal and Final Game

Participants: Teams of Class IX and XII students from the CISCE Schools.

Awards: Exciting Prizes and participation certificates for all.

5. Outline of the Robo Villa – IRC 2024

- A) One Team can participate from each school.
- B) Each team must build/assemble their own robot as per the game theme.
- C) Game consists of ONE round where robot plays in two modes.
- D) Robot will play Gate Keeper Mode and Construct Mode.
- E) The robot must perform the following tasks
 - I) Gate Keeper Task
 - II) Green Villa Task
 - III) Build House Task
 - IV) Flag the Villa Task

- F) The robot has to place the Gate Key (Disc – 200mm*200mm) on the Gate Lock.
- G) The robot playing in Gate Keeper Mode is required to use the black path to place the Gate Key on the Gate Lock.
- H) Once the Gate Key is placed the Red path is open for the robot to use for building the Villa.
- I) If the robot cannot place Gate Key, then the robot will have to use only the black path to build the house.
- J) After above task, team playing in construct mode should do three tasks:
 - I) Green Villa Task
 - II) Build House Task
 - III) Flag the Villa Task
- K) The robot has to place two plants (which are in the form of a Disc – 150*500 mm) into the plant pits.
- L) The robot must place at least one plant in one place to become eligible for building the complete villa.
- M) Out of four walls, two walls are preplaced by the opponent team in the game field.
- N) The robot must place the other two walls and the villa roof.
- O) The team building the villa must place the bricks (400*100 mm) in designated slots in the building arena to complete the wall and roof portion of the villa.
- P) The game ends if the team places the IRC flag on the villa first or the total game duration of **three minutes** is over.
- Q) Two competing teams (Team A and Team B) will play at the same time in two arenas starting at the same time.
- R) Points will be calculated based on the number of walls placed in the designated building arena and the number of plants placed in the planting pits.
- S) The team placing the IRC flag will get bonus points.
- T) The winner will be announced based on the highest score.

6. Roles of the robot

- Gate Keeper Mode
- Construct Mode

7. Game Field

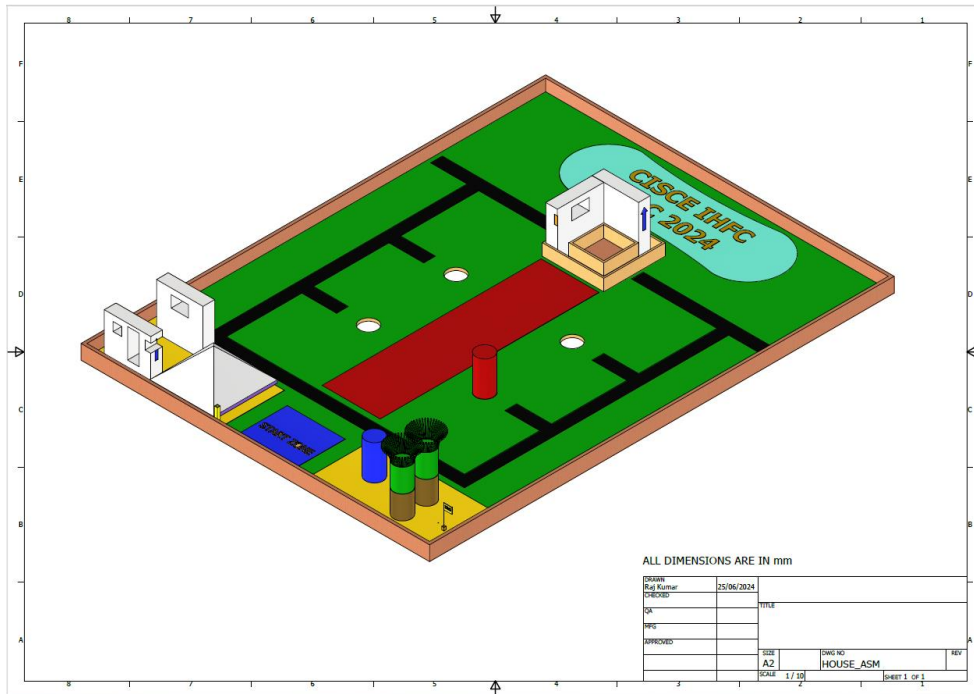


Figure 2: Perspective View of the Game Field

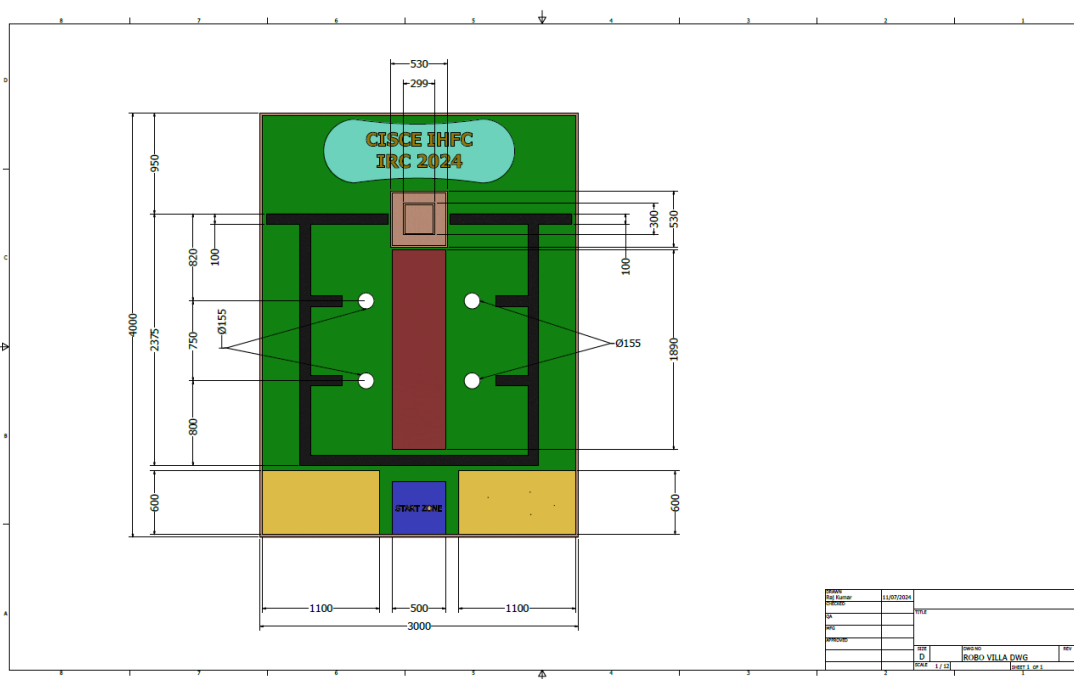


Figure 3: Top View with dimensions

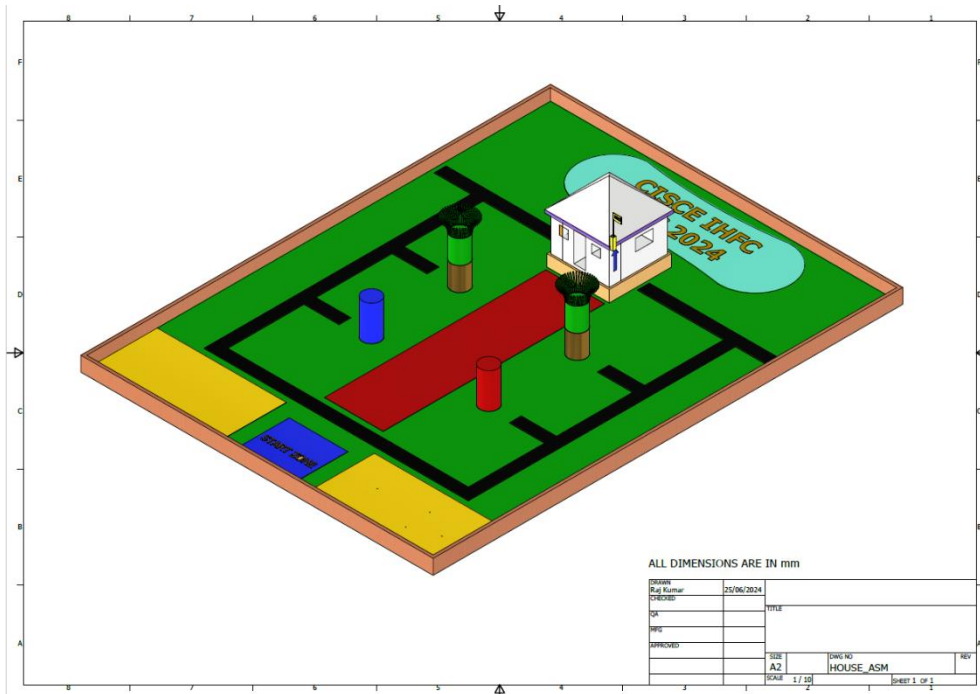


Figure 4: Robo Villa

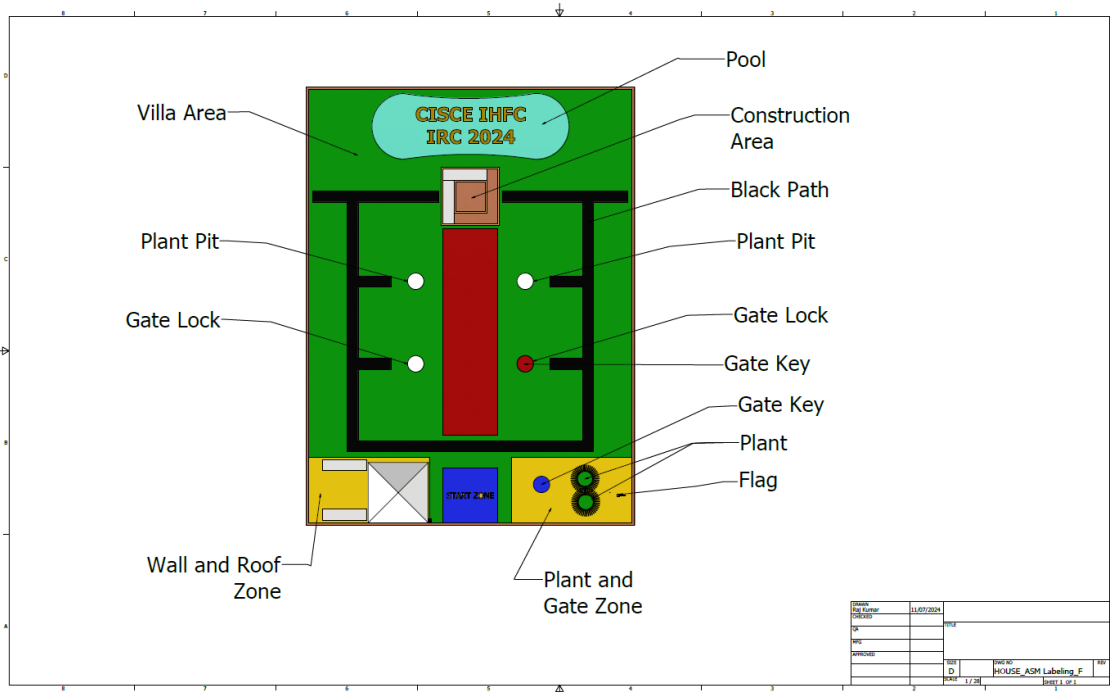


Figure 5: Robo Villa with labelling

8. Terms and Definitions

Given below are the terms relevant to this game, and their definitions respectively.

Table 2

S. No.	Term	Definition
1.	Team	There will be two teams named Team A (Red) and Team B (Blue)
2.	Robot	Each team must build ONE Robot, that can work in two roles. They are Gate Keeper Mode and Construct Mode. The dimension of the robot: Width: Less than or equal to 500 mm. Length: Less than or equal to 500 mm. Height: No restriction.
3.	Gate Keeper Mode	In the Gate Keeper mode, the robot will push/pick and place gate key on the gate lock. There will be one key available for opening the gate. Placing the key on the lock will open the red road for the robot.
4.	Construct Mode	In the construct mode, the robot will place the plant on the planting pit in front of the house, aiming to score points. The robot must place at least one plant in front of the house to be eligible for building the house. The robot can move to the construction area to build the house by placing the walls.
5.	Plant (Green)	It is a cylindrical disc of dimensions 500mm (height) × 150 mm diameter. The material used is POLYURETHANE Foam of density 14 kg per cubic meter. Note that “top” and “bottom” surfaces of each disc are uncollated. The robot in the construct mode will get 10 points for each placement of plants in the planting pit.
6.	Plant Pit	There are two plant pits (hole) for placing the plants, in construct mode.
7.	Gate Key (Blue/Red)	It is a cylindrical disc of dimensions 200mm (height) × 150mm (diameter). The material used is POLYURETHANE Foam of density 14 kg per cubic meter. Note that “top” and “bottom” surfaces of each disc are uncollated. The key is used to place on the gate lock.
8.	Gate Lock	It is a hole in the Villa Area with a diameter of 150mm. The Gate key will have to be inserted on the Gate Lock, for the red road to be opened for movement of the robot.
9.	Wall	The walls are kept on the left side of the Robo Villa. These planks are the walls of the house. The dimensions of the walls are 400mm *100 mm.
10.	Construction Area	The construction area is composed of 2 square boxes (Refer to Figure 3). The center square box has an area of 530 mm *530 mm.
11.	Flag	The team will place the flag on the top of the house
12.	Black Path	The robot in Gate Keeping Mode can use the path for placing the gate on the gate lock. The robot in Construct mode also can use the path for placing the plants on the plant pit. It can also be used as a path for construction of the house.
13.	Red Path	For the robot in construct mode, the red path opens after placing the gate key on the gate lock. The robot in construct mode can use the red path for placing the plant. The robot should plant at least one plant to be eligible for house construction. The red path can also be used for the construction of the house.
14.	Pool	The robot is restricted from moving into the pool.

15.	Villa Area	The game field is the area where the robot must complete its tasks. It is a square area sized 4000 mm X 3000 mm.
16.	Start Zone (SZ)	The position from where the robot push/pick & place the walls/plants/gates/Flag to perform. The dimensions of BSZ are 750 mm X 750 mm.
17.	Rounds	Each game will have two roles. There is only one round. In each round, Team A and B robot plays in two roles, Gatekeeping mode and Construct mode.
18.	Setting Time	Referee will give the ONE-minute setting time before each Round starts.
19.	Referee	The person who manages the game considers all rules and regulations.
20.	Judge	The person who awards the points and declares the winner for each game.

9. Game Procedure

The total time allotted for each game is THREE minutes. Setting time will be ONE minute before the start of each round.

9.1. Game Procedure

- a. Before the game
 - i. Each team places their robots in their respective start zones in the field.
 - ii. Referee will signal for setting time before each Round starts.
 - iii. Two walls and roof will be placed in the wall and roof zone
 - iv. Two plants, Gate Key and Flag are placed in the Plant and Gate zone.
 - v. Two walls are kept on the construction area.

Once setting is done, the team can start their respective robots on Referee's signal.

- b. During the game
 - i. The game will start with the robot in respective start zone.
 - ii. All team members should stay outside of the game field except when they need to retry and push the start button of the robot.
 - iii. Team members should not touch the walls, roof, plants, Gate key.
 - iv. When the game starts, the robot in Gate Keeper Mode will push/pick and place the key and try to lock the gate lock in the Villa Area. There will be one Gate key available that can be used to lock the gate lock using the black road.
 - v. Once the gate is unlocked, the red road also opens for movement of the robot.
 - vi. The robot can move to place plants. It has to plant at least one plant to be eligible for building the house
 - vii. The robot now moves to the wall and roof zone to pick /push the walls and walls in the construction area.
 - viii. If the robot comes out from the SZ, the referee may ask the team for retry.
 - ix. The final task of the game end whenever the robot hosts the flag on the roof top.
 - x. All the tasks of the game must be completed within three minutes.

9.2. Scoring of the game

Gate Keeper Task		
S. No.	Placing the Gate Key	Points
1	Left Key	10
Green Villa Task		
S. No.	Plant in front of the house	Points
1	Right 1 st Plant pit	10
2	Left 2 nd Plant pit	10
Build House Task		
S. No.	Placing the walls	Points
1	Front wall	10
2	Right Side wall	10
3	Roof	20
Flag the Villa Task		
S. No.	Flag on the Roof	Points
1	IRC flag on the roof	30
Total Points		100

9.3. Deciding the Winner

The team with the highest total score wins. If there is a tie, the winner will be decided in the following order:

- a. Team that completes the whole task in the least time.
- b. Teams that unlock the red road with least time.
- c. Final decision taken by Judge

9.4. Retry

- a. If needed the team can apply for a retry within the first 15 secs of any mode. Retrying can only be done with the permission of the referee.
- b. If the robot violates the rules, the robot will be forced to retry according to the referee's instructions.
- c. When retrying, the robots should return to their respective start zones and restart.
- d. There is no retry if any of the objects (plants, walls and flag) goes outside the Game field

10. Robot Specification

- a. Each robot cannot be split into sub-units or connected by flexible cords during the game. The robots are not allowed to use suction to stick on the game field.
- b. The robots in the contest must be built by team members from the same school.
- c. Teams are not allowed to bring or set up any equipment around the field, except robots and spare parts used in the game and some tools/devices used in resetting time.
- d. Robot Size
 1. At the game beginning, each robot must not be more than 500 mm in length and 500 mm in width.
 2. When cables are used to control a robot, the length of the cable is unlimited. However, the teams should be careful to avoid cable winding with the field facilities and game objects. Both for wireless or cable operation, the team members are not allowed to enter the game field.
- e. Weight of Robots
 1. The total weight of two robots, controllers, the primary set of batteries used in the game must not exceed 30 Kg
 2. Any other equipment that the team brings for setup purposes, tools, air containers, and backup batteries (of the same type as that initially installed in the robot) are exempt
- i. Power Source of Robots
 1. Each team shall prepare its own power source.
 2. Teams can use only batteries, compressed air, and/or elastic force as power source.
 3. The nominal voltage of any battery used in the robot, controller, and any other devices during the game shall not exceed 24V. However, when connecting batteries in series, the total voltage must be 24V or less.
 4. Measured voltage should be set to 42V or less by actual measurement. If the power supply system includes multiple isolated circuits, voltage in each system must be 42V or less.
 5. Teams using compressed air must use either a container made for the purpose or a plastic bottle in pristine condition prepared appropriately. Air pressure must not exceed 600 kPa.
 6. Any power source deemed dangerous may be banned from use.
- j. During the test run before the contest, referees, will inspect the robots. Robots that do not meet the above requirements will not be allowed to participate in the game.

11. Violations

- i. The robot must not use the green field in the villa area.
- ii. The robot playing shouldn't touch the walls placed in the construction area, the round will be immediately stopped.
- iii. The robot is not allowed to touch the pool at backyard.

12. Disqualifications

A team will be disqualified if it takes any of the following actions during the game:

- i. The design and build of the robot are not following the rulebook.
- ii. The team intentionally damages or tries to damage the field, facilities, game objects.
- iii. The team performs any acts that are not in the spirit of fair play.
- iv. The team fails to obey instructions or warnings issued by referees.

13. Safety

The design and build of robots should not pose any kind of danger to any person at the competition scene. All robots must be designed and built to cause no damage to any robots of the opposing team or the field. Give below are some safety measures to be followed.

- a. Attach an actual emergency stop button on the robot. A real visible emergency stop button is to be connected to each of the robots to enable one to shut down the robot in case of loss of control at any time.
- b. Team members must wear running shoes, helmets, and safety goggles during the games and test runs.
- c. The use of explosives, fire, or dangerous chemicals is prohibited.
- d. Accumulators, lead-acid batteries are not allowed.
- e. In designing and using the laser or infrared beams, 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 spectators' eyes.
- f. If the laser is used, it must be of class 2 or less.
- g. When using radio for signal transmission, teams must design systems, circuits, and mechanisms and ensure they do not go out of control and/or move dangerously even if a short circuit occurs or a connection is broken.
- h. When teams have multiple power supply systems, teams must design the circuits and mechanisms not to go out of control or move dangerously no matter which power supply is lost or regardless of the order of turning on the power.
- i. To avoid starting a fire or smoking by the overload of a motor stall and so on, proper current limiting devices such as a circuit breaker must be installed to power supply circuits.
- j. Use wires, connectors, terminals, etc., with a rated current equal to or higher than the assumed maximum current.

14. Teams

- a. There is only one Team from each CISCE school
- b. Each team consists maximum of five (5) students (called team members) and minimum of three (3), and one (1) mentor.
- c. They must be students of the same school as a team.
- d. Once registered, students cannot change their teams members/team name.

15. Annexure

TABLE I	
Details of CISCE Inter-school Robotics Championship- IRC 2024	
Team Formulation	<p>Each school can register one team for the competition. 1000 teams will be registered on a first come, first serve basis.</p> <p>School teams will consist of a maximum of 5 and a minimum of 3 members from grades IX to XII.</p>
Theme of the Competition	<p>IRC 2024 Theme: “Industry”</p> <p>The contemporary industrial landscape is undergoing a profound transformation driven by advancements in robotics and automation technologies. From streamlined production processes to enhanced efficiency and safety standards, robotics has become the cornerstone of modern manufacturing. IRC 2024 aims to celebrate and further accelerate the integration of robotics into the industry by inviting participants to design, build, and showcase innovative robotic solutions tailored to industrial applications.</p>
Preliminary Screening	<p>The registered 1000 teams will undergo a basic boot camp and then participate in a preliminary screening round to shortlist 480 teams for the next round. The screening will be based on the basic boot camp.</p>
Stage 1	<p>480 teams will submit a design document for the game as Stage 1 submission out of which 240 teams will be shortlisted.</p>
Stage 2	<p>Stage 2 involves video submission by the 240 teams out of which 120 teams will be shortlisted for the “Zonal Round”.</p>
Zonal Round	<p>In the Zonal Round, teams will compete to showcase the minimum skills requirement to build a small prototype of the robot using modular electronics and mechanical parts for the given task of moderate difficulty level. There will be 30 teams participating in the Zonal Round at each of the 4 Zones. In total, 120 teams compete to qualify as part of 24 teams (Top 6 teams of the Zonal round from each zone) in the Grand Finale at Hyderabad.</p>
National Round	<p>The top 24 teams of each of the four zones will participate in the Final round at CISCE CoE at Hyderabad. Each team will build a wheeled mobile robot with the specifications provided to perform tasks based on this year’s theme Industry.</p>
Prizes and Certification	<p>Certificates of Participation and attractive prizes for winning school and teams.</p>

TABLE II
Timeline of CISCE Inter-school Robotics Championship- IRC 2024

S.No.	Schedule	Timelines
1	Registration	
	• Start	Monday, July 15, 2024
	• End	Tuesday, July 30, 2024
2	Bootcamp (Online mode: 10 parallel batches- outside school hours)	
	• Start	Monday, August 5, 2024
	• End	Friday, August 16, 2024
3	Preliminary Submission Last Date	Tuesday, August 20, 2024
	Result	Monday, August 26, 2024
4	Announcement & Orientation of IRC Final Game	Thursday, August 29, 2024
5	Advance Bootcamp (Online mode- outside school hours)	
	• Start	Saturday, August 31, 2024
	• End	Wednesday, September 4, 2024
6	Design Document Submission, Stage 1	Wednesday, September 11, 2024
	Result	Monday, September 16, 2024
7	Video Submission, Stage 2	Monday, September 30, 2024
	Result of Video Submission	Tuesday, October 8, 2024
8	Zonals – Tentative* – Kolkata	Tuesday, October 22, 2024
	• Lucknow	Friday, October 25, 2024
	• Mumbai	Monday, October 28, 2024
	• Bengaluru	Tuesday, November 5, 2024
9	Finals – Hyderabad	Monday, November 11, 2024