RBE 1001 Final Project Rules D '18

1. Objective

1.1. To design and build a radio- and autonomously-controlled robot that will demonstrate competence in the fundamental disciplines covered in RBE1001, to that end, each robot's design must include:

1.1.1. Sensor-based autonomous behavior,

1.1.2. At least one power transmission (with other than a 1:1 gear train),

1.1.3. A lifting device that affects the challenge outcome, and

1.1.4. A team-built custom electronic circuit that adds functionality to the robot.

1.2. All to score points in the following challenge (as demonstrated during the IDR and CDR in Labs 6 and 7 and/or the OED).

2. The Challenge

2.1. Definitions:

2.1.1. ORB (Ordinary Robot Ball): One of 50 ping pong balls (1.5" dia).

2.1.2. ASTEROID (Awesome Spherical Tennisball Extraterrestrially Rotating and Orbiting In a Disk): One of twelve tennis balls (2.7" dia).

2.1.3. STAR: One kickball (8.5" dia).

2.1.4. BLACK HOLE (Bot Landing Area Coalitions Keep Holding in Order to not Lose the Endgame) : A 18" square platform in the center of the field raised 1.7" above the carpet with a 2" dia hole in its center.

2.1.5. BASE (Big Awesome Starting Exoplanets) : An area at the end of the field defined by the field borders and the outside edge of a line of tape, 18" from the field border.

2.1.6. ORBITS (Orb Retaining Big Incredibly Tall Structure) : One of six structures consisting of a clear 3" OD, 2 ⅞" ID tube with a funnel on the top and a square support on the bottom.

2.1.6.1. Only objects solely supported by the inside surfaces of the ORBITS tube, bottom cap, or funnel, or by another scored object will be scored.

2.1.6.2. ORBITS Level 1: Height above carpet is 6".

2.1.6.3. ORBITS Level 2: Height above carpet is 12".

2.1.6.4. ORBITS Level 3: Height above carpet is 18".

2.1.7. RAMP (Referee Assisted Magic Platform): A structure that is used to dump the ORBs and ASTEROIDs onto the STAR. The front support is 18" tall and is located 21" away from the back field border.

2.1.8. OED (Optional Extended Demonstration): An end-of-term tournament style opportunity for teams to demonstrate their robot capabilities beyond the Lab 7 CDR.

2.2. Field Description

2.2.1. The field is 8' x 12'. A wooden frame that is 2.5" high and 0.75" thick forms the field wall and defines the outer boundaries of the playing area.

2.2.2. The main surface of the playing area is "high-traffic" carpet that may have minor bumps and surface irregularities.

2.2.3. Teams will begin with every part of their robot within the boundaries of their BASE. Teams may start with up to 4 ORBs fully supported by their robot. Any ORB not fully supported by the robots will be given to the referee to enter the field via the RAMP after the AUTONOMOUS period.

2.2.4. The STAR starts in the center of the BLACK HOLE.

2.2.5. All field dimensions should be considered to be +/- 0.5".

2.3. Challenge Timing

2.3.1. Each challenge will consist of an AUTONOMOUS period, TELEOPERATION period, and an END GAME period.

2.3.2. Referees will enter ORBs and ASTEROIDs to the field via the RAMP at the following predetermined times:

2.3.2.1. ORBs: At the end of AUTONOMOUS.

2.3.2.2. ASTEROIDs: One minute into TELEOPERATION, during the Driver Switch.

2.3.3. The STAR may only be contacted by a robot during the END GAME.

2.4. Challenge Scoring

2.4.1. Scores will be calculated when all items on the field have come to rest.

2.4.2. At the end of Autonomous, scores will be calculated as follows:

2.4.2.1. Basic ORB scoring:

2.4.2.1.1. BASE: 1 point

2.4.2.1.2. ORBITS Level 1: 2 points

2.4.2.1.3. ORBITS Level 2: 3 points

2.4.2.1.4. ORBITS Level 3: 5 points

2.4.2.2. Auto ORB Multiplier: All basic ORB scores are muliplied by 2^{N-1}, where N is the number of ORBITS successfully scored into. (EG, if a robot scores 1 ORB into both ORBITS Level 1 and Level 2 then 2 ORBs into ORBIT Level 3, the score is $((1x2)+(1x3)+(2x5))x2^{3-1}$=60 points.)

2.4.3. At the end of the challenge, additional scores will be calculated as follows:

2.4.3.1. ORBs scored:

2.4.3.1.1. BASE: 1 point

2.4.3.1.2. ORBITS Level 1: 2 points

2.4.3.1.3. ORBITS Level 2: 3 points

2.4.3.1.4. ORBITS Level 3: 5 points

2.4.3.2. ASTEROIDs scored:

2.4.3.2.1. BASE: 2 points

2.4.3.2.2. ORBITS Level 1: 8 points

2.4.3.2.3. ORBITS Level 2: 12 points

2.4.3.2.4. ORBITS Level 3: 20 points

2.4.3.3. If the STAR is scored on an ORBITS:

2.4.3.3.1. The value of all ORBs and ASTEROIDs scored in that ORBITS is doubled.

2.4.3.3.2. 5 points are added to that COALITION's score.

2.4.3.4. Each robot supported only by the BLACK HOLE: 25 points.

2.5. Driver Rotation

2.5.1. During each challenge, teams will be required to switch their drivers halfway through the driver control period. There will be a 10 second period during which the drivers must complete the switch or the robot will be disabled.

2.6. Challenge Sequence

2.6.1. Each match is 2 minutes and 20 seconds long

2.6.2. 0-20 seconds - Robots enabled under AUTONOMOUS.

2.6.3. 20 seconds - Points scored in autonomous are awarded. ORBs dropped. TELEOPERATION begin.

2.6.4. 20-80 seconds - Robot under first Driver Control

2.6.5. 75-85 seconds - Driver switch period. ASTEROIDs dropped.

2.6.6. 80-140 seconds - Robot under second Driver Control

2.6.7. 110-140 seconds – END GAME. The STAR may be moved.

2.6.8. 140 seconds - Challenge ends, robots disabled.

3. The Robot

3.1. Size/Weight Restriction

3.1.1. At the start of each match, every part of the robot except for the flag holder (drinking straw, as specified in rule 3.4.4) must fit, unconstrained, in a stable position, within a box 15.25" by 15.25" by 18" in any orientation. The robot must be fully self-supported, in contact only with the horizontal, carpeted (or taped) surface of the playing field.

3.1.2. Each robot's weight must not exceed 10.0 lbs.

3.2. Construction Rules

3.2.1. The robot must be designed to operate by reacting only against features within the confines of the playing field boundaries.

3.2.2. Gaining traction by use of adhesives or by abrading or breaking the surface of the playing field is not allowed and will be considered field damage and subject to disqualification.

3.2.3. Teams must have their assigned team number clearly marked on their robot such that it is visible from 15' away. The numbers should be at least 1" high, 1/8" thickness and be on opposing sides of the robot.

3.2.4. Teams must place a standard drinking straw, cut to 6" long, such that the straw is perpendicular to the ground on their robot. The top of the straw must extend above the top of the robot while in its starting configuration.

3.2.5. A robot may not intentionally contaminate the playing field or an opponent's robot with lubricants or other debris.

3.3. Building Constraints

3.3.1. Each team will be expected to use parts only from the RBE1001 VEX Kit, The AK120 Parts Buffet and the extra parts (eg additional motors, sensors, pneumatics, etc) available through the bid process, unless specified on the additional materials list below.

3.3.2. Teams may NOT modify any of the VEX electronics or motors. Modification of items on the additional materials list is permitted.

3.3.3. Teams may use any 7.2V battery. Only one battery may be used on the robot at a time.

3.4. Materials

3.4.1. Any amount of materials in the Additional Materials List will be allowed.

3.4.2. Additional Materials List

3.4.2.1. Plastic sheet, up to 0.25" thick

3.4.2.2. Metal sheet, up to 0.125" thick

3.4.2.3. Any aluminum, steel, or plastic round shaft or tubing up to 0.5" diameter

3.4.2.4. Any bearings

3.4.2.5. Plywood or wood up to 0.5" thickness

3.4.2.6. "Foam rubber" or styrofoam like materials up to 0.75" thickness

3.4.2.7. Cardboard or foam-board

3.4.2.8. String or twine

3.4.2.9. Any springs or elastic bands (must be designed to satisfy referee safety concerns on accidental release)

3.4.2.10. Fasteners, washers, adhesives, and tape

3.4.2.11. Lubricants used to reduce friction within parts of your robot

3.4.2.12. Non-functional decorations

3.4.2.13. Paper, plastic-wrap, aluminum foil, fabric or any paper or cloth-like material

3.4.2.14. Plastic 3D printed parts no bigger than a 3" in length width or height.

3.4.2.15. Any sensors

3.5. Energy Sources

3.5.1. The energy used by the devices in the competition must come solely from:

3.5.1.1. A change in altitude of the center of gravity of the device.

3.5.1.2. Energy stored by deformation of any approved materials.

3.5.1.3. Electrical energy delivered by the battery to the electronics and motors provided with the kit.

3.5.1.4. Pressure stored in the pneumatics system, not to exceed 100 psi.

3.6. Electronics

3.6.1. Teams must keep clear and easy access to their robot controller, specifically the power switch. The indicator lights on the front or top of the controller must also be clearly visible.

3.6.2. All teams are required to program their robot using the template provided in lab.

4. Optional Extended Demonstration (OED) Structure

4.1. Teams will have the opportunity to demonstrate their robot in the OED. Instructors will be looking for improved accomplishment over what was demonstrated in Lab #7. The "accomplishment" portion of the final project cannot go down during the OED. The two top teams at the completion of the OED will receive a 25% decriment return bonus of their overall final project score.

4.2. COALITION: Two teams which work together in a match during the OED. Coalitions are chosen randomly. A coalition's teams always share a color.

4.3. Matches

4.3.1. Teams will be designated to be on either "Red" or "Blue" coalition during the OED on a match-by-match basis as noted on the match list.

4.3.1.1. Prior to each match, a colored flag must be inserted into the robot's straw to designate the coalition color. Flags will be provided at the start of the match and must be removed from the robot before leaving the playing field. Multiple infractions of this rule may result in a disqualification at the discretion of the referees.

4.3.2. Teams will be given their schedule of matches no later than the start of the first match of the OED.

4.3.3. The winner of the match is the coalition that has the most points after the match has been scored and penalties assessed; they will be awarded 2 match points. Tied-match colalitions will each receive 1 match point; losing colatitions will receive 0 match points.

4.3.4. Ranking: At the end of the OED matches, teams will be ranked based on the following:

4.3.4.1. Highest total match points.

4.3.4.2. If tied, highest total point score.

4.4. General Rules

4.4.1. All members of a team must drive their robot within the first two official matches of the OED in which the team places a robot on the field. Once all members have

driven the robot, teams must continue switching drivers during their matches but any team member may come to the field to drive.

4.4.2. All referee decisions regarding rules of play and judgments are final.

4.4.3. Repeated or intentional receiving of penalties will result in a disqualification.

4.4.4. Definitions

4.4.4.1. Pinning: A robot is considered pinned when it is being held against a field obstacle or another robot by a robot from an opposing coalition and cannot move in any direction. The closest referee will begin counting the pin from the moment the pin begins.

4.4.4.2. Penalty: 15 points are added to the opposing coalition's score.

4.4.4.3. Disqualification: Robots may be disqualified based on their actions that violate the rules of the game. If a referee calls for a disqualification, the offending robot will receive a loss. The remaining members of both coalitions will receive their regular match points.

4.4.5. Robot and Field Interaction Rules

4.4.5.1. Any ORB or ASTEROID that leaves the playing area during a match will be returned to the field by a referee via the RAMP. If the STAR leaves the playing field it will not be returned to the field.

4.4.5.2. Robots may NOT intentionally descore ORBs or ASTEROIDs from the ORBITS.

4.4.5.2.1. If a team violates this rule, they will receive one penalty for each of the removed objects.

4.4.5.2.2. The removed objects will be returned to the respective scoring area, regardless of the intent of removing them.

4.4.5.3. Robots may not interact with the STAR in any manner except in the last 30 secs of the match (the End Game). Each violation will earn the COALITION one penalty and the robot's coalition will not receive points or the multiplier for the STAR on any of their ORBITs. If the STAR is intentionally removed from the field, the offending coalition will be disqualified.

4.4.5.4. Robots may not intentionally tip an opposing team's robot. The tipping robot will be disqualified from the match if, in the referee's opinion, they initiated a lifting action that results in tipping.

4.4.5.5. Robots will be disabled for physically interacting with anything outside of the field.

4.4.5.6. If a robot is pinned for five seconds, the pinning team receives a penalty. An additional penalty will be applied every five seconds until the offending robot has moved at least 12" away from the pinned robot. Per rule 4.3.3, robots that accumulate multiple pinning penalties in a match are subject to immediate disqualification from the match.

4.4.5.7. All parts of the robot must remain attached to the robot for the duration of the match and must not cause any hazard of entanglement to the other robots. Any infraction of this rule may result in an immediate disqualification. Minor pieces that unintentionally become detached from the robot, do not affect the outcome of the match, or are the result of improper design/construction will not cause a disqualification.

4.4.5.8. Teams are allowed to modify their robots between matches as long as the robot remains compliant with all specifications and rules after the modification. Any significant modification should be brought to the attention of the referees or head inspector prior to the start of the team's next match. Teams may be subject to re-inspection at the discretion of the referees/head inspector. While teams are allowed to modify their robots between matches, multiple robots per team are not allowed.

4.5. Safety Rules

4.5.1. Team members may interact with their robot during a match only through the transmissions of the radio-controller. Only designated Drivers or Operators may be in contact with the controls during the match.

4.5.1.1. All team members who will be driving during the match must stay within their coalition station for the entirety of the match. Repeat violations of this rule may result in disqualification at the discretion of the referees.

4.5.2. Team members may not extend any part of their body onto the field. Violations of this rule will lead to disqualification at the discretion of the referee.

4.5.3. Referees will disqualify any robot they deem to be a safety hazard.

4.5.4. Referees may request that teams alter any portion of their robots that are considered safety hazards or damaging to the playing field or scoring objects at any point during the competition. It is the right of the referees to prevent teams from playing in matches until such changes are made to the robot.

4.5.5. Damage to the playing field, the objects, or the control system may result in the disabling or disqualification of the robot at the discretion of the referees. If the referee determines that further movement of the robot would result in field damage, it will be disabled.

4.5.6. Strategies aimed solely at the destruction of or damage to an opponent's robot or the field are not in the spirit of the competition and will not be allowed and may result in disqualification.