CSARC

COMPUTER SCIENCE &
ROBOTICS CERTIFICATION

Certification in LEGO® Robotics for Learners Examination Syllabus

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Introduction

The **Certification in LEGO® Robotics for Learners** aims to provide a standardised skill benchmark for LEGO based robotics systems, in particular the LEGO® Mindstorms® Education EV3 (45544) and LEGO® Education SPIKE™ Prime (45678). The certification is meant to be platform agnostic and the focus is on testing candidates on core skills in programming, LEGO-based mechanical design, and mission-based problem solving.

Assessment Objectives Overview

1. Programming Theory

Candidates should be able to demonstrate proficiency in:

1.1 Usage of single If-Else conditional structure.
1.2 Usage of single conditional loop.
1.3 Usage of single for loop and forever loop
1.4 Usage of nested If-Else conditional structure.
1.5 Usage of nested conditional loop.
1.6 Usage of variables and math operations.
1.7 Implementation of user-defined functions.

2. Robot Building

Candidates should be able to demonstrate proficiency in:

2.1 Constructing a LEGO robot with 2 motors by following a graphical construction manual.
2.2 Constructing a LEGO robot with 2 motors without a construction manual.
2.3 Mounting sensor attachment.
2.4 Mounting motor attachment.

3. Practical Programming

Candidates should be able to solve a mission-based problem involving:

3.1 Precise motor movement paths.
3.2 Line following with single colour sensor.
3.3 Line following with multiple colour sensors and overcoming line junctions.
3.5 Error correction algorithms.
3.6 Data collection and respond to random set of playfield elements.

Scheme of Assessment

1. Certificate Tiers

1.1 Each grade examination has a maximum possible score of 25.

1.2 Candidates will be issued a certificate if they meet the passing score requirement.

1.3 Certificates have different tier levels based on the score requirements as set out in **Table 1**: Certificate Tier Levels

Table 1: Certificate Tier Levels

Score Requirement	Certificate Tier
≥ 13	Pass
≥ 16	Merit
≥ 20	Distinction
≥ 23	High Distinction

2. Examination Format

2.1 The format of each grade examination will follow a score weightage as set out in **Table 2**:

Table 2: Examination Format and Weightage

Assessment Criteria	Grade 1	Grade 2 & 3
Programming Theory questions Interpreting programs or spotting mistakes with a given program	5	5
Robot Building Designing and building a robot with appropriate attachments to effectively complete a task	10	5
Practical Programming Mission solving task with score awarded when candidates successfully demonstrate completion of mission tasks.	10	15

Certificate Examination Syllabus by Grade

Grade 1

Programming Theory	
1.1	**Usage of Move Tank blocks to make precise movement** • Movement by motor degrees (Most important for precision) • Movement by motor rotations • Movement by seconds
1.2	**Move tank blocks for precise turns** • Turning on one wheel • Turning in a wide arc • Turning on the spot
1.3	**Usage of If-Else (Switch Block)** • Single sensor/motor/button logic condition • Logic operators: >, <, =
1.4	**Usage of Conditional/Infinite loop** • Single sensor/motor/button logic condition • Logic operators: >, <, =
Robot Building	
2.1	**Constructing a LEGO robot with 2 motors by following a graphical construction manual** • Scores will be awarded for correct assembly of parts as per construction manual
2.3	**Mounting sensor attachment** • Sensor has to be mounted at appropriate location and orientation on the robot • Sensor has to be mounted securely and not be loose / shaky
Practical programming	
3.1	**Precise motor movement paths**
3.2	**Line following with single colour sensor** • Usage of single light sensor to follow a line accurately

Grade 2

Programming Theory	
1.1	**Usage of Move Tank blocks** • "Off" mode for motor braking • "On" mode for continuous looped movement
1.2	**Usage of nested If-Else conditional structure** • Sensor/motor/button logic condition • Logic operators: >, <, =
1.3	**Usage of single conditional loop** • Single sensor/motor/button logic condition • Logic operators: >, <, =
1.4	**Usage of delays (Wait Block)**
Robot Building	
2.1	**Constructing a LEGO robot with 2 motors**
2.3	**Mounting grabbing device** • Building grabbing device to correct dimensions to capture objective block • Mounting at appropriate height
Practical programming	
3.1	**Line Following using 2 light sensors** • Movement at appropriate speed to ensure accuracy • Following line for a certain time/distance using conditional loops • Navigation of Junctions
3.2	**Movement with Conditional Loops** • Forward or turning movement that will stop based on sensor conditions

Grade 3

Programming Theory	
1.1	**Proportional Error Correction programs** • Concept of proportional guidance (Using difference between destination and location to make proportionate motor correction) • Turning the robot to face a bearing using gyro and proportional guidance • Making robot move forward while accurately facing a bearing using gyro and proportional guidance • Following a line using light sensors and proportional guidance
1.2	**Usage of Mathematics block and Variables** • Addition/Subtraction/Multiplication/Division • Usage of Math block in conjunction with variables to record data points
Robot Building	
2.1	**Constructing a LEGO robot with 2 motors**
2.3	**Motorised Grabbing device** • Building a motorised grabbing device appropriate for the objective cube • Stable mounting of the grabbing device on the robot in a location that makes sense • Partial marks may be given for an appropriate non-motorised grabbing device
Practical programming	
3.1	**Proportional Guidance programs** • Using Gyro or Light Sensor, whichever the mission requires for navigation
3.2	**Colour Scanning** • Scanning colour of objective cubes • Cube to be brought to different objective locations based on colour
3.3	**Variables and Mathematics** • Formula will be provided • Using variables to record inputs from sensors • Using math block to calculate output