

4740-45007-Lab Items for Robotics and Engineering Workshop Practice Lab for EE Department, CUI-Lahore Campus

Sr. #	Item Name & Specification	Qty.		Required model / Brands
1	TurtleBot Mobile Robot Platform (ROS-Based Autonomous Robot) TurtleBot or Equivalent 1. Main Controller & Processing Unit • Single Board Computer (SBC): Raspberry Pi 4 (or equivalent) ○ Quad-core processor (≥ 1.5 GHz), ≥ 4 GB RAM ○ MicroSD storage (≥ 32 GB) • Robot Controller Board: OpenCR 1.0 (ARM Cortex-M7 based) • Operating System: Ubuntu Linux with ROS / ROS 2 support 2. Locomotion System • Drive Type: Differential drive mobile robot • Motors: 2 $\times$ DC geared motors with encoders • Wheels: 2 drive wheels + 1 caster wheel • Motor Driver: Integrated with OpenCR controller 3. Sensors • LiDAR Sensor (360° scanning): ○ Example: LDS-01 / equivalent ○ Range: ~ 3.5 m or higher ○ Used for SLAM (Simultaneous Localization and Mapping) • IMU (Inertial Measurement Unit): ○ Gyroscope + accelerometer for orientation tracking • Wheel Encoders: ○ For odometry and motion estimation • Optional Camera (depending on variant): ○ RGB camera for vision-based applications 4. Power System • Battery: Rechargeable Li-ion battery (≈ 1800–5200 mAh depending on model) • Battery Charger: Compatible charger with protection circuit • Power Management: Onboard power distribution via controller 5. Communication Interfaces • Wireless Communication: Wi-Fi (802.11 b/g/n/ac) • USB Ports: For peripherals and debugging • Remote Operation: SSH / ROS network communication 6. Mechanical Structure • Chassis: Modular frame (plastic/aluminum depending on model)	Nos.	2	TurtleBot or Equivalent

	• Mounting Plates: Multi-layer structure for sensors and expansion • Payload Support: Expandable for additional sensors 7. Software & Development Environment • Framework: ROS / ROS 2 (Robot Operating System) • Programming Languages: Python, C++ • Simulation Support: Gazebo / RViz • Pre-built Packages: Navigation, SLAM, mapping, teleoperation 8. Accessories • USB cables, power cables • Assembly tools (basic kit) • Preloaded firmware and documentation 9. Documentation & Learning Resources • Official tutorials and manuals (ROS-based learning) • Open-source packages and community support 10. Applications in Lab • Autonomous navigation and SLAM • Path planning and control algorithms • Multi-robot coordination • AI and computer vision integration • Robotics and ROS training			
2	Hiwonder AiArm Vision Robot Arm Kit (AI-Based Educational Robotic Manipulator) Hiwonder or Equivalent 1. Main Controller & Processing Unit • Core Controller: CoreX intelligent controller (multi-functional embedded system) • Processor: ESP32-based control system • Functions: ○ Motion control ○ Sensor integration ○ AI module interfacing • Expansion Ports: Multiple 4-pin interfaces for sensors and modules 2. Degrees of Freedom (DOF) & Actuation • DOF: 6 DOF (5 joints + gripper) • Actuators: Intelligent serial bus servos ○ Models: LX-15D, HTD-20L, HX-06L • Features: ○ Position feedback ○ High torque and precision ○ Clean wiring (bus-based communication) 3. Vision System (AI Module) • Camera Module: WonderCam AI Vision Module • Capabilities: ○ Object detection and recognition ○ Color sorting ○ Barcode recognition ○ Face tracking	Nos.	4	Hiwonder or Equivalent

	• AI Features: Pre-trained machine learning algorithms for real-time vision tasks 4. End Effector • Gripper Type: Mechanical gripper • Functionality: ○ Object grasping and manipulation ○ Vision-guided pick-and-place 5. Sensors & Expansion • Built-in / Supported Sensors: ○ Ultrasonic sensor (distance measurement) ○ Infrared receiver ○ Sound module • Expandable Modules: ○ Fan module (AI tracking demo) ○ Display modules ○ Additional IoT/AI sensors 6. Mechanical Structure • Material: Aluminum alloy + PC plastic casing • Dimensions: ~285 × 162 × 440 mm • Weight: ~1.7 kg • Design: Lightweight, modular, lab-friendly 7. Power System • Power Supply: ○ 7.5V DC adapter (7A) • Power Interface: Standard DC input 8. Communication & Control • Control Methods: ○ PC software control ○ Offline programming (manual teaching) ○ Wireless/app control (optional) • Programming Support: ○ Scratch (block-based learning) ○ Python (advanced programming) 9. Software & Development Environment • Software Platform: WonderCode + PC control software • Programming Languages: Scratch 3.0, Python • Control Techniques: ○ Inverse kinematics ○ Motion sequencing ○ AI-based decision making 10. Accessories & Package Contents • AI vision module (WonderCam) • Base platform and mounting board • Object sorting props (e.g., bins) • Sensor kit and wiring • Power adapter			
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	- Assembly and user manuals 11. Applications in Lab - AI-based object recognition and sorting - Robotics kinematics and control - Human-robot interaction - Computer vision experiments - STEM education and demonstrations			
3	UAV F450 Quadcopter Hardware-in-the-Loop (HIL) Setup Electronics Pro (epro.pk) or equivalent Flight Controller (Pixhawk) - Pixhawk 6X / Cube Orange BLDC Motors ESCs (Electronic Speed Controllers) Propellers UAV Frame (F450 Quadcopter Frame) Battery - LiPo Battery Sensors - Accelerometer - Gyroscope - Magnetometer - Barometer - GPS Module (optional) <i>Used for attitude, altitude, and position estimation.</i> Communication Modules - Telemetry Radio - RC Receiver/Transmitter - WiFi Module (optional) <i>Used for communication with the ground station.</i> Computer / Laptop <i>Used for simulator execution and communication with Pixhawk during HIL operation.</i> Recommended Specifications: - Intel Core i5/i7 Processor 8–16 GB RAM Simulation Software - Gazebo - jMAVSim - AirSim - MATLAB/Simulink <i>Used for simulating UAV dynamics and environment.</i> Ground Control Software - QGroundControl - Mission Planner <i>Used for monitoring, calibration, telemetry, and parameter tuning.</i> USB Cable / Telemetry Link <i>Used for communication between Pixhawk and the computer during HIL simulation.</i> RC Transmitter & Receiver - FlySky FS-i6	Nos.	02	Electronics Pro (epro.pk) or equivalent

	○ Radiomaster ○ FrSky			
4	Computer / Laptop Paklap.pk or equivalent Used for simulator execution and communication with Pixhawk during HIL operation. Recommended Specifications: ○ Intel Core i5/i7 Processor ○ 8–16 GB RAM	Nos.	02	Paklap.pk or equivalent
5	ESP32 kit Complete with cable Local or Imported • Microcontroller: ESP32-WROOM, ESP32-CAM, and ESP32-C3 modules • Components: Breadboard, resistors, jumper wires (male/female), LEDs, buttons, and sensors (temperature/humidity DHT11/16, ultrasonic). • Modules: Relay modules, servo motors, RFID readers, and OLED displays	Nos.	12	Local or Imported or equivalent
6	L298N Local or China motor driver	Nos.	12	Local or China or equivalent
7	MPU9250 for 6 DOF orientation Local or China	Nos.	12	Local or China or equivalent

8	Bench Drilling Machine—13mm, 350W model with complete accessories TOTAL or Equivalent 1 Year Warranty, CUI-Lahore Campus will retain 5% of the total value of Warranty Items. The retention money will be released after the warranty period (mentioned in BoQs) subject to a satisfactory report by the end user. The warranty period will be counted from the date of delivery.	pcs	5	TOTAL or Equivalent
9	Home Electrical Wiring Trainer board (as per sample) 1 Year onsite Warranty CUI-Lahore Campus will retain 5% of the total value of Warranty Items. The retention money will be released after the warranty period (mentioned in BoQs) subject to a satisfactory report by the end user. The warranty period will be counted from the date of delivery.	pcs	5	Local or China or equivalent
10	Vernier Caliper – 150mm, stainless steel, 0.02mm graduation, with locking screw Local or China	Pcs	5	Local or China or equivalent
11	Micrometer Screw Gauge – 0–25mm, 0.01mm graduation, ratchet thimble Local or China	Pcs	5	Local or China or equivalent
12	Incandescent Bulb with Holder – 60W, B22, bracket-mounted Local or China	pcs	10	Local or China or equivalent

13	Fluorescent Tube Light Fixture – 20W with starter, choke/ballast & tube (2-ft) Local or China	pcs	10	Local or China or equivalent
14	CFL Bulb with Holder – 15W, E27, with mounting bracket Philips or Equivalent	pcs	10	Philips or Equivalent
15	LED Bulb with Holder – 9W, E27, with mounting bracket Philips or Equivalent	pcs	10	Philips or Equivalent
16	HID Lamp with Ballast – 70W metal halide, with fixture (shared, lab-wide) Local or China	pcs	3	Local or China or equivalent
17	Mild Steel Cylindrical Bar – Ø25mm × 200mm, for turning/facing/threading practice Local or China	pcs	20	Local or China or equivalent
18	Metallic Sheet (MS) – 3mm thickness, 200×200mm, for filing/drilling/tapping Local or China	pcs	10	Local or China or equivalent
19	Mild Steel Strips – 50×100×3mm flat bar for butt welding joint practice Local or China	pcs	25	Local or China or equivalent
20	Welding Electrodes – E6013, Ø2.5mm, 5kg pack (AC stick welding) Local or China	packs	2	Local or China or equivalent
21	Steel Wire Brush – for weld slag removal (pack of 5) Local or China	pack	1	Local or China or equivalent
22	Test Lead Colour: Red, Both ends: Stackable shrouded 4mm banana Plugs, Length: 1.5meter with Silicon Rubber Insulation, AWG: 22, Amp: 10, 30KV-DC, Sample available in Power Lab Local or China 	Nos.	48	Local or China or equivalent
23	Test Lead Colour: Yellow, Both ends: Stackable shrouded 4mm banana Plugs, Length: 1.5meter with Silicon Rubber Insulation, AWG: 22, Amp: 10, 30KV-DC, Sample available in Power Lab Local or China	Nos	48	Local or China or equivalent
24	Test Lead Colour: Blue, Both ends: Stackable shrouded 4mm banana Plugs, Length: 1.5meter with Silicon Rubber Insulation, AWG: 22, Amp: 10, 30KV-DC, Sample available in Power Lab Local or China	Nos	48	Local or China or equivalent

25	Test Lead Colour: Black, Both ends: Stackable shrouded 4mm banana Plugs, Length: 1.5meter with Silicon Rubber Insulation, AWG: 22, Amp: 10, 30KV-DC, Sample available in Power Lab Local or China	Nos	48	Local or China or equivalent
26	Glass Fuse – glass type 5×20mm, 1A, 220VAC (box of 100 pcs) Local or China	boxes	3	Local or China or equivalent
27	Glass Fuse – glass type 5×20mm, 2A , 220VAC (box of 100 pcs) Local or China	boxes	3	Local or China or equivalent
28	Glass Fuse – glass type 5×20mm, 5A , 220VAC (box of 100 pcs) Local or China	boxes	3	Local or China or equivalent
29	Glass Fuse – glass type 5×20mm, 10A , 220VAC (box of 100 pcs) Local or China	boxes	3	Local or China or equivalent
30	Ferric Chloride – for PCB etching, anhydrous granules, 1kg pack Local or China	kg	3	Local or China or equivalent
31	PCB Transfer Paper – A4, laser-printable toner transfer (pack of 10 sheets) Local or China	packs	5	Local or China or equivalent
32	Nitrile Chemical Gloves – powder-free, disposable (box of 100 pcs) Local or China	box	1	Local or China or equivalent
33	Isopropyl Alcohol (IPA) – 99%, 500ml bottle, for PCB cleaning Local or China	btl	2	Local or China or equivalent
34	Cotton Swabs – for PCB cleaning post-soldering (pack of 200 pcs) Local or China	packs	2	Local or China or equivalent
35	Copper PCB Vero Board (15cmx7cm) single sided Local or China	Pcs	50	Local or China or equivalent
36	Solder Tip Cleaner Paste – 20g tin Local or China	pcs	5	Local or China or equivalent

- **LoI / PO shall be issued to lowest evaluated bidders on item wise basis. Bidders are required to submit a single CDR (after totaling individual CDR amounts of the quoted items). Please avoid separate CDRs for respective quoted items.**
- **To emphasize quality requirements of the items, the brand names / model are mentioned in the technical specifications (where applicable) in this document. Equivalent brand may be accepted subject to ensuring quality standards, compatibility / functionality and specification requirements otherwise may be rejected.**