TECH ZONE

Embedded Systems Diploma

From your first circuit to a printed circuit board you designed yourself, then artificial intelligence on real hardware. For university students, graduates and adults.

Length
100+ hours

Format
Online and on-site

Practice
Weekly assignments

Finish
A graduation project



The complete path

One continuous path: electronics and Arduino, your own PCB design, AI with computer vision, and preparation for the job market.

Module 1: Arduino and electronics basics

- Resistors, capacitors, LEDs and motors in a circuit
- Arduino programming in C and C++
- Digital and analog input and output, and PWM
- Temperature, humidity, motion and light sensors
- Displays, and the I2C, SPI and UART protocols
- Servos, motors, Bluetooth and Wi-Fi

Module 2: PCB design and fabrication

- Board types: single-sided, double-sided, multilayer
- Materials, SMD and through-hole parts
- EasyEDA, Proteus and Altium
- Drawing the schematic, placing parts, routing
- Design rules, clearances and trace widths
- Gerber files for manufacturing
- Three projects, ending with a double-sided board you solder and run

Module 3: AI with Arduino, and computer vision

- Machine learning and neural network basics
- Running AI on hardware
- Python fundamentals
- OpenCV and image processing
- Object recognition that controls the Arduino

Module 4: Follow-up and job-market preparation

- Weekly and monthly assessment
- Homework after every lecture, with a solution video
- One-to-one follow-up all week
- CV writing and a LinkedIn profile
- Interview preparation, and follow-up after the diploma

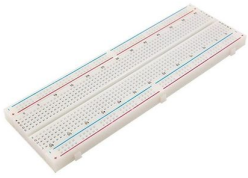
Module 1: the kit

Every student gets a complete hands-on kit for Module 1. These are the parts the projects are built from.

Controller and basics



Arduino Uno and cable
The board at the centre of every project.



Breadboard
Build and change circuits fast, no soldering.



Jumper wires
Connect boards, sensors and modules.



Resistors
Limit current, protect LEDs and inputs.



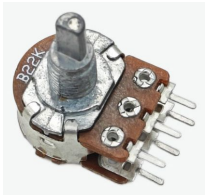
LEDs
Status lights, and brightness with PWM.



Push buttons (5)
Inputs for controls, menus and games.



Buzzer
Alarms, feedback tones and melodies.



Potentiometer
Analog input for values, speed and limits.



Traffic light module
Red, yellow and green LEDs on one board.



Keypad
Codes and choices, for locks and menus.



Joystick
Two-axis control for cars and robots.



Batteries and holder
Portable power for robots and cars.

Sensors and display



LCD with I2C
A text display on just two wires.



DHT11
Temperature and humidity.



Ultrasonic sensor
Distance, and obstacles ahead.



IR sensor
Nearby objects and passing cars.



IR receiver
Reads commands from a remote control.



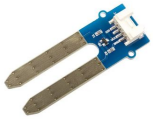
Flame sensor
Flame detection for fire alarms.



Gas sensor
Gas and smoke, for safety alarms.



Water level sensor
Water level in tanks and containers.



Soil moisture sensor
How wet the soil is, for plant care.

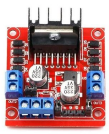
Motion, switching and wireless



Servo motor
Exact angles for barriers, locks and arms.



2 DC motors and wheels
Drive a robot or a car.



Motor driver
Controls motor speed and direction safely.



2WD chassis
Robot frame with a free caster wheel.



Relay module
Switches bigger loads such as lamps and fans.



DC fan
Cooling and ventilation projects.



Bluetooth module
Wireless control from a phone.



NRF24L01
Long-range radio link between two boards.

Every part here is sold in the TECH ZONE shop.

Module 1: the projects

Eighteen projects. The six core projects come first, and the last three put the water level, soil and DHT11 sensors to use.

1 **Smart parking** — Core
IR sensors detect cars arriving and leaving, a servo barrier opens, and the LCD shows free spaces.
Parts: Arduino Uno, IR sensor, servo, LCD, LEDs

2 **Automatic night light** — Core
A light sensor switches a lamp on by itself when it gets dark.
Parts: Arduino Uno, LDR, LEDs, resistors

3 **Obstacle-avoiding robot** — Core
The robot scans with an ultrasonic sensor on a servo and steers around obstacles by itself.
Parts: Arduino Uno, ultrasonic, servo, motor driver, DC motors, 2WD chassis, batteries

4 **Robot control from a smartphone** — Core
Drive the robot from a phone app over Bluetooth.
Parts: Arduino Uno, Bluetooth, motor driver, DC motors, 2WD chassis, batteries

5 **Lighting control with motion** — Core
Lights switch on when someone moves, and off after a delay.
Parts: Arduino Uno, PIR sensor, relay, LEDs

6 **Lighting control from a smartphone** — Core
Turn lamps on and off from a phone app over Bluetooth.
Parts: Arduino Uno, Bluetooth, relay, LEDs

7 **Car controlled from 1 km away**
A joystick transmitter drives a car over a long-range radio link (line of sight, PA+LNA module).
Parts: Arduino Uno, NRF24L01, joystick, motor driver, DC motors, 2WD chassis, batteries

8 **Playing the Chrome T-Rex game**
A light sensor spots obstacles on the screen and a servo presses the jump key.
Parts: Arduino Uno, LDR, servo

9 **Voice-controlled lighting**
Say a command to the phone and the lights respond.
Parts: Arduino Uno, Bluetooth, relay, LEDs

Module 1: the projects, continued

10 Smart safe box

Enter a code on the keypad to unlock with a servo; wrong codes sound the buzzer.

Parts: Arduino Uno, keypad, servo, LCD, buzzer

11 Robot control by IR remote

Steer the robot with a standard IR remote.

Parts: Arduino Uno, IR receiver, motor driver, DC motors, 2WD chassis

12 Smoke detection alarm

Detects smoke or gas, sounds an alarm and starts the ventilation fan.

Parts: Arduino Uno, gas sensor, buzzer, LEDs, DC fan, LCD

13 Robot control by voice

Voice commands from the phone drive the robot.

Parts: Arduino Uno, Bluetooth, motor driver, DC motors, 2WD chassis

14 Car parking alarm

Beeps faster as a car gets closer, with a traffic-light distance warning.

Parts: Arduino Uno, ultrasonic, buzzer, traffic light, LCD

15 Digital piano

Push buttons play notes through the buzzer, and a knob shifts the pitch.

Parts: Arduino Uno, push buttons, buzzer, potentiometer

16 Water tank level monitor Suggested

Shows the tank level and alarms when it is too low or about to overflow.

Parts: Arduino Uno, water level sensor, buzzer, LCD, LEDs

17 Smart plant monitor Suggested

Reads soil moisture, temperature and humidity, and warns when the plant needs water.

Parts: Arduino Uno, soil sensor, DHT11, LCD, LEDs

18 Smart climate fan Suggested

Turns the fan on by itself when the room passes the set temperature.

Parts: Arduino Uno, DHT11, DC fan, relay, LCD

Module 2: from schematic to finished board

Students move from breadboards to real printed circuit boards, following the same workflow used in industry.

1 **Schematic**
Draw the circuit

2 **Footprints**
Choose parts and packages

3 **Placement**
Arrange the components

4 **Routing**
Draw the copper traces

5 **Design rules check**
Verify spacing and widths

6 **Gerber export**
Files for the factory

7 **Solder and test**
Assemble and power up

Board types

Board	What it is	Typical use
Single-sided	Copper on one side only. Simple and cheap; may need a few jumper wires.	Learning boards, simple modules
Double-sided	Copper on both sides, joined through plated holes (vias). Easier routing and a ground plane.	Controllers, shields, most hobby and product boards
Multilayer	Four or more copper layers stacked inside the board.	Dense, high-speed or complex designs

Component packages

Through-hole (THT)

Leads pass through holes and are soldered on the other side. Easy to hand-solder and sturdy. Best for first boards.

Surface-mount (SMD)

Parts sit on surface pads. Smaller and lighter, used in almost all modern products. Needs steadier soldering.

Design software

EasyEDA	Free and browser-based, with ordering straight from the manufacturer. Ideal for first boards.
Proteus	Circuit simulation and PCB layout in one tool.
Altium Designer	The professional design suite used in industry.

Module 2: design rules and Gerber files

Design rules students learn

Trace width

Signal traces can be thin, but power traces must get wider the more current they carry. Where space allows, wider is safer.

Clearance

Keep the spacing between traces, pads and the board edge at or above the manufacturer's minimum, and increase it for higher voltages.

Component placement

Group parts by function, keep connectors at the edges, keep hot parts apart and decoupling capacitors close to the chip.

Power and ground

Route power first and keep ground paths short and solid. On double-sided boards, use a ground plane.

Pads, holes and vias

Match pad and hole sizes to the component leads so parts fit and solder well.

Silkscreen labels

Mark part names, pin 1 and polarity so the board is easy to assemble and debug.

Gerber files: what the factory receives

Copper layers	Top and bottom traces and pads
Solder mask and silkscreen	The coloured coating with pad openings, and the printed labels
Drill file	Hole positions and sizes
Board outline	The shape and size of the board

Module 2: three PCB projects

Three projects of rising difficulty. The last is a double-sided board that students solder and run themselves.

1 **Blink and buzz starter board** — Single-sided, through-hole

The first full trip from schematic to finished board: an LED, resistor, push button and buzzer on a small single-sided board.

Parts: LEDs, resistors, push buttons, buzzer, your own PCB
Skills: schematic capture, footprints, simple routing, hand soldering

2 **Arduino sensor shield** — Single-sided, through-hole

A plug-in shield with clean headers for the DHT11, ultrasonic sensor and I2C LCD, so projects stop depending on loose jumper wires.

Parts: Arduino Uno, DHT11, ultrasonic, LCD, your own PCB
Skills: headers, connectors, clean layout, design rules check

3 **Smart home controller board** — Double-sided

The final board: a double-sided controller with relay outputs, status LEDs and sensor headers, designed, ordered, soldered and powered up by the student. The camera-controlled smart home in Module 3 runs on it.

Parts: Arduino Uno, relay, LEDs, ESP8266, your own PCB
Skills: double-sided routing, ground plane, Gerber export, assembly, debugging

Project ideas can be adjusted to the syllabus. Always check your PCB manufacturer's minimum trace width, spacing and drill sizes before exporting Gerber files.

Module 3: AI that controls the real world

The camera does the seeing, Python and OpenCV do the thinking, and the Arduino acts on the result.

Webcam Captures live video → **Python and OpenCV** Finds faces, hands or people → **USB serial** Sends a short command → **Arduino Uno** Reads the command → **Outputs** Relays, servos, motors, LCD

1 Camera-controlled smart home

The webcam watches the student's hand: showing 1 to 4 fingers switches device 1 to 4 on a relay board. OpenCV reads the gesture and sends the command to the Arduino over USB.

Parts: Webcam, Python and OpenCV, Arduino Uno, relay, LEDs, DC fan
Skills: hand detection, serial communication, relay control

2 Presence-aware home

The camera sees whether anyone is in the room. Lights switch on when someone is there and off when the room stays empty; the fan follows the temperature.

Parts: Webcam, Python and OpenCV, Arduino Uno, relay, DHT11, DC fan, LCD
Skills: person detection, timers, combining sensors

3 Face-recognition door lock

The camera recognises registered faces and tells the Arduino to open a servo lock; unknown faces sound the buzzer.

Parts: Webcam, Python and OpenCV, Arduino Uno, servo, LCD, buzzer
Skills: face detection and recognition, servo control

Module 3: AI projects, continued

4 **Face-tracking pan-tilt camera**
Two servos move the camera to keep a detected face in the centre of the frame.
Parts: Webcam, Python and OpenCV, Arduino Uno, 2 servos
Skills: object tracking, control loops, servo control

5 **Gesture-controlled robot car**
Hand gestures in front of the camera drive the car forward, back, left and right.
Parts: Webcam, Python and OpenCV, Arduino Uno, Bluetooth, motor driver, DC motors, 2WD chassis
Skills: computer vision, Bluetooth, motor control

6 **AI fire watch**
The camera looks for flame-like colour and motion while the flame and gas sensors confirm it; then the alarm sounds and the ventilation fan starts.
Parts: Webcam, Python and OpenCV, Arduino Uno, flame sensor, gas sensor, buzzer, DC fan, relay
Skills: combining sensors, alarms, safety logic

Safety: classroom demos use low-voltage loads (LEDs, small DC fans). Wiring to mains power is never part of the class; it must be done by a qualified electrician.

Module 4: follow-up and job-market preparation

Weekly and monthly assessment
Regular checkpoints show students exactly where they stand.

Homework and solution video
Every lecture ends with an assignment, and a solution video follows.

One-to-one follow-up
Individual support through the week, not only in class.

CV and LinkedIn
Students write a strong CV and polish their LinkedIn profile.

Interview preparation
Mock interviews and practical preparation for the job market.

After the diploma
Follow-up continues once the course is over.

Graduation project

Every student finishes with a graduation project that combines circuits and code with, as they choose, a custom PCB or an AI vision system, documented and demonstrated.

Join the next group

Message us on WhatsApp at **0101 098 4875** to book a place or ask about dates. Details are also at **techzoneegypt.com/learn/university**.