

ROBOTICS CLASSES – ADVANCED

This curriculum is designed to introduce students to robotics and programming through hands-on projects using Arduino. The curriculum is structured over **12 weeks** (3 months), with each week focusing on a new concept or skill, combining theory and practical exercises. The students will need an **Arduino Kit** and a laptop/computer for programming.

Objectives:

- Understand basic electronics and robotics principles.
- Learn to program the Arduino microcontroller.
- Build and control simple robots using sensors and actuators.
- Foster creativity, problem-solving, and engineering skills.

Week 1: Introduction to Robotics and Arduino

- **Topics Covered:**
 - What is Robotics? Understanding robotics applications in real life.
 - Introduction to Arduino: What is it, and why do we use it?
 - Overview of the Arduino Uno board and its components (pins, power, reset button).
- **Activities:**
 - Setting up Arduino IDE (software).

- Uploading the "Blink" example code to the Arduino to make an LED blink.

Week 2: Basic Electronics Concepts

- **Topics Covered:**

- Introduction to basic electronic components: resistors, capacitors, LEDs, and breadboards.
- Ohm's Law and understanding voltage, current, and resistance.

- **Activities:**

- Build simple circuits using an LED and resistor on a breadboard.
- Experiment with different resistor values to understand current flow.

Week 3: Introduction to Programming in Arduino (C/C++)

- **Topics Covered:**

- Understanding Arduino IDE and code structure (void setup, void loop).
- Basics of Arduino programming: variables, loops, and functions.

- **Activities:**

- Modify the Blink example to control the LED blink rate.
- Create a simple program to turn on/off an LED using a push button.

Week 4: Sensors and Inputs (Digital)

- **Topics Covered:**

- Understanding digital inputs.
- Introduction to basic sensors (e.g., push buttons, switches).

- **Activities:**

- Build a circuit to detect a button press and turn on an LED.
- Create a simple reaction timer project using an LED and push button.

Week 5: Sensors and Inputs (Analog)

- **Topics Covered:**

- Difference between digital and analog signals.
- Introduction to analog sensors (e.g., potentiometers, light sensors).

- **Activities:**

- Use a potentiometer to control the brightness of an LED.
- Read analog values from a sensor (light sensor) and display them on the Serial Monitor.

Week 6: Using Motors and Actuators

- **Topics Covered:**

- Introduction to motors: DC motors, servos, and stepper motors.
- Using transistors and motor drivers to control motors.

- **Activities:**

- Control a servo motor using a potentiometer.
- Build a simple fan project using a DC motor.

Week 7: Introduction to Libraries and Functions

- **Topics Covered:**

- Understanding libraries in Arduino (e.g., Servo library).
- How to include and use external libraries.

- **Activities:**

- Use the Servo library to control multiple servos in different patterns.
- Modify the code to make the motor move in a specific range.

Week 8: Understanding Ultrasonic Sensors

- **Topics Covered:**

- Introduction to ultrasonic distance sensors (e.g., HC-SR04).
- Understanding how sound waves are used to measure distance.

- **Activities:**

- Build a distance measurement project using the HC-SR04 sensor and display the readings on the Serial Monitor.
- Use the sensor to trigger an action (e.g., turn on a light or sound a buzzer when an object is near).

Week 9: Controlling a Robot Car

- **Topics Covered:**

- Integrating motors and sensors to create a basic robot.
- Understanding motor drivers (L298N).

- **Activities:**

- Build a simple robot car using motors and motor drivers.
- Write code to control the robot's movement (forward, backward, turn left, turn right).

Week 10: Line Following Robot

- **Topics Covered:**

- Introduction to IR sensors and their use in detecting lines.
- Concept of feedback control in robots.

- **Activities:**

- Build a line-following robot using IR sensors and a motor driver.
- Program the robot to follow a black line on a white surface.

Week 11: Obstacle Avoidance Robot

- **Topics Covered:**

- Using ultrasonic sensors for obstacle detection.

- Implementing decision-making algorithms in robotics.
- **Activities:**
 - Modify the robot car to avoid obstacles using the ultrasonic sensor.
 - Create a project where the robot stops or changes direction when it detects an obstacle.

Week 12: Final Project and Presentation

- **Topics Covered:**
 - Review of key concepts learned.
 - Tips for designing and planning projects.
- **Activities:**
 - Students work on their final project, combining all the skills learned (e.g., a robot that can follow lines and avoid obstacles).
 - Final project presentation: Students present their project to the class, explaining the design, code, and challenges faced.
