

SPARK LABS

Class 2 Syllabus

Grade Level: 9th – 12th

Micro Controller: ESP32

Material: Kit Provided

Equipment: Highly Recommended Laptop

Program Date: September 26th – December 5th (2026)

Calendar

Date	Session
September 26, 2026	Session 1
October 10th, 2026	Session 1 Check Up - Remote
October 31st, 2026	Session 2
November 14th, 2026	Session 2 Check Up - Remote
November 21st, 2026	Session 3
December 5th, 2026	Session Check Up - Remote

Course Summary

Students will develop a thorough understanding of microcontrollers, basic electronic circuits, wiring diagrams, and coding. They will learn how individual components work together to create complete, functional systems and will apply this knowledge by designing, building, and testing projects that address real-world problems. Students will also be introduced to 3D modeling and learn how to incorporate 3D-printed components into their projects to develop practical solutions.

In addition to hands-on engineering and design, students will explore the scientific principles behind their projects, including the relevant concepts of physics, mathematics, and materials science. They will learn how electronic components function at increasingly fundamental levels, including an introduction to the atomic principles that influence their behavior.

Students will also learn about electronic communication methods and protocols, including how devices exchange information and communicate with one another. They will apply these concepts by incorporating communication technologies into their own projects.

Each month, students will work within a specific project theme. They will use the skills and concepts they have learned to design, build, program, test, troubleshoot, and refine projects related to that month's theme. Through this process, students will develop practical skills in engineering, electronics, programming, problem-solving, communication, and creative design.

Course Goals

- Develop a strong understanding of microcontrollers, electronics, basic circuits, wiring diagrams, and coding.
- Understand how individual components work together to create complete, functional systems.
- Develop foundational skills in 3D modeling and learn how to incorporate 3D-designed and 3D-printed components into projects.

- Understand how the components used in projects function, including the underlying principles of electricity, mathematics, electronics, and materials at the atomic level.
- Apply communication protocols and technologies to create interconnected and responsive projects.
- Encourage creativity, innovation, critical thinking, and independent problem-solving.
- Design, build, test, troubleshoot projects based on a different theme each month, applying previously learned skills and concepts to new challenges.

Session 1

Theme: Ocean / Marine Engineering

Example Projects:

- Sonar Obstacle Detector
- Ocean Depth Monitor
- Marine Temperature Monitor
- Smart Buoy
- Underwater Warning System
- Fish Tank Environment Monitor
- Water-Level Alert System
- Ocean Navigation Lights
- Marine Proximity Alarm
- Underwater Signal Beacon
- Mini Lighthouse Controller
- Submarine Control Panel

The outputs to be displayed on a smart phone or desktop/laptop using the internet

Session 1 Content

- Intro to Micro Controllers and the breadboard
- Engineering Design Process: define, specify, build, iterate, present
- Using desktop to control basic components over WIFI
- What electricity is: current, voltage, and resistance
- Explaining basic components (LEDs, resistors, buttons, buzzers)
- Reading a wiring diagram and building from it
- Intro to 3d modeling
- Overview of essential materials used in projects (epoxy, 3d printer filaments, puddings, glues, fiberglass)
- Building Project 1 according to the theme using explained components
- Giving Example Project and Guides
- Assigning Projects as HW and providing guides

Session 2

Theme: Environmental Engineering

Projects:

- Trail Camera / Detector
- Plant Moisture Monitor
- Temperature Alert System
- Light-Level Monitor

- Smart Plant Watering System
- Mini Weather Station
- Air-Conditioning Control Model
- Automatic Night Light
- Smart Door Sensor
- Motion-Activated Light
- Environmental Alert Beacon
- Water-Level Monitor
- Energy Usage Indicator

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Session 2 Content

- Explaining sensor components (potentiometer, light sensor, ultrasonic, temperature)
- Intro to different communication protocols
- Using phone applications to control components and create advanced inputs
- How a sensor turns something physical into a signal
- Reading sensor values and displaying them on an LCD displays
- Making Project 2 that relates to environment using components learned
- Assigning Project, Giving Examples and Guides

Session 3

Theme: Aeronautical / Aerospace Engineering

Projects:

- Electronic Gyroscope & Display
- Aircraft Proximity Alarm
- Runway Warning Lights
- Landing Zone Detector
- Altitude Detector Warning System
- Spacecraft Control Panel w Rocket Launch Countdown System
- Satellite Communication Beacon
- Obstacle Detection System
- Aircraft Simulator Throttle Control
- Emergency Landing Beacon
- Space Station Wind & Environmental Monitor

Session 3 Content:

- Intro to flight physics, related components and concepts
- Explanation of gyroscopes, types of motors and their applications
- Components of rc planes & control systems
- Overview of Satellites & what role they play
- Explanation of components used in flight (accelerometer, barometer, radars, etc.)
- Example Projects Guides and Ideas

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In-Between Sessions

The in-between sessions will be Progress Check Sessions where students can receive help, update us on their progress, and get additional guidance on their projects.

Attendance is required for all sessions. Prior arrangements must be made if a student expects to miss a session.