

Certificate Course in

ARDUINO based Embedded System Design

1. Objective:

An embedded system is a combination of hardware and software provided that both should be synchronized with each other. Some examples are as follows: industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines etc. The Arduino is an open-source computer hardware/software platform for building digital devices and interactive objects that can sense and control the physical world around them. In this course you will learn how the Arduino platform works in terms of the physical board and libraries and the IDE (Integrated Development Environment). The course will also cover programming the Arduino using C code and accessing the pins on the board via the software to control external devices. With this module student will get firm career growth in Electronics domain.

2. Learning Outcome:

After the completion of the course, the students will be specialized in Embedded System Design using Arduino.

3. Duration of the course: 300 hrs.

4. Minimum eligibility criteria to enroll in this course:

- a) Pursuing or Passed students of Diploma in Electronics / Electronics & Communication / Electrical/Electrical & Electronics/Instrumentation/Biomedical/Computer Science/Information Technology
- b) Pursuing or Passed students of B.Sc./B.Tech/M.Tech/M.Sc./Polytechnic/ITI in Electronics & Communication/ Instrumentation/Computer Science/Information Technology.

5. Syllabus Outline:

Sr. No.	Topics	No. of Hours
1.	Embedded System design : Basics	60
2.	Learning Arduino Platform	60
3.	The basic sensors and actuators using Arduino	60
4.	Controlling embedded system based devices using Arduino	60
5.	Project Based on embedded system design using Arduino board.	60
	Total Hours	300

6. Detailed Syllabus:

a) Embedded System design: Basics	(60 hours)
i. Introduction to embedded systems.	(5 hours)
ii. Components of embedded system.	(5 hours)
iii. Advantages and applications of embedded systems.	(5 hours)
iv. Examples of real time embedded systems and how they are manufactured industry ready.	(5 hours)
v. Different Microcontroller Architectures (CISC, RISC, ARISC).	(5 hours)
vi. Internal Resources & Hardware Chips in Details.	(5 hours)
vii. History of AVR Microcontrollers and Features.	(5 hours)
viii. Memory Architectures (RAM/ROM).	(5 hours)
<i>Assignment Q/A</i>	20 hours
b) Learning Arduino Platform	(60 hours)
i. Introduction to ARDUINO, ARDUINO History and Family.	(10 hours)
ii. Programming in Embedded-C, Concepts of C language.	(20 hours)
iii. General Hardware Interfacings:	(10 hours)
• LED's	
• Switches	
• Seven Segment Display	
• Multi Segment Displays	
• Relays (AC Appliance Control)	
• LCD	
• Buzzer	
• IR Sensors	
• Other Digital Sensors	
iv. <i>Assignment Q/A</i>	(20 hours)
c) The basic sensors and actuators using Arduino	(60 hours)
i. Introduction to sensors and actuators.	(10 hours)
ii. How to connect and work with different sensors, such as Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal etc to ARDUINO Board.	(10 hours)
iii. Reading various sensor data on serial monitor and LCD Display.	(10 hours)
iv. Functioning of actuator.	(10 hours)
v. <i>Assignment Q/A</i>	(20 hours)
d) Controlling embedded system based devices using Arduino	(60 hours)
i. Reading data from analog and digital sensors on Serial Monitor/LCD Monitor.	(10 hours)
ii. Work with LED Controlled by Switch/potentiometer, 7 segment displays.	(10 hours)
iii. How to connect relays and servomotors to ARDUINO Board.	(10 hours)

- iv. Work with 5V/3V Power supply using voltage regulator IC'S. (10 hours)
v. Assignment Q/A (20 hours)

e) Project Based on embedded system design using Arduino board (60 hours)

Students can make many projects on ARDUINO Based Embedded systems, few are listed below, i.e.:

1. ARDUINO based home automation.
2. ARDUINO Based Solar Street Light system.
3. ARDUINO Based Alarm Clock.
4. ARDUINO Based Car Parking System, etc.

7. Software(s) required:

Arduino Integrated Development Environment Software.

8. Hardware(s) required:

1. ARDUINO UNO R3 with USB Cable

- Microcontroller ATmega328
- Operating Voltage: 5V
- Input Voltage (Recommended): 7-12V
- Digital I or O Pins 14 (of which 6 provide PWM output)
- Flash memory 32 KB (ATmega328) of which 0.5 KB used by bootloader SRAM 2 KB (ATmega328).

2. ARDUINO Development Board with ATmega8 Microcontroller - ATMEL ATmega 8

- Operating Voltage - 5V
- Input voltage - 6V-20V
- Digital I/O pins - 14 out of which 6 provide PWM
- Analog Input Pins – 8
- DC Current per I/O pin - 40mA.
- Flash Memory - 16KB
- SRAM - 1KB
- EEPROM - 512Bytes
- Clock Speed 16 MHz
- USB-UART converter
- Proper Indicator LED's
- USB/ EXT input voltage
- 5V output supply pins – 3
- 3.3 V output supply pins – 1

- Breadboard Compatibility (dimension of a 40 pin DIP IC)
- Special GND and VCC pins for every data pins.

9. Books / Reference material required:

1. Arduino-Based Embedded Systems : By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury.
2. <https://www.arduino.cc/en/Tutorial/HomePage>
3. Arduino Made Simple by Ashwin Pajankar
4. Embedded C, Pont, Michael J
5. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver
6. ARM System - On - Chip Architecture, Furber, Steve
7. Assembly Language Programming: ARM Cortex - M3: Mahout, Vincent

10. Job Opportunities after completing this course:

After completing this course, participants can become:

1. Embedded System Engineer.
 2. Embedded Programmer.
 3. Embedded software Engineer/hardware engineer.
 4. Embedded System Specialist.
 5. Specialist in Arduino based Embedded System Design.
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