

Course: Arduino

Course Code: noc20-hs10

Session: 2019-20

Duration: Self Paced (4 Month)

Assessment procedures: Proctored certification Exam (100%)

Basic Level

1. Overview of Arduino
 - Learning objectives of Arduino
 - Prerequisites for learning Basic level Arduino tutorials
 - Prerequisites for learning Intermediate level Arduino tutorials
 - Who can use Arduino?
 - Glimpse of Spoken Tutorials available on Arduino series
2. Electronic components and connections
 - Breadboard and its internal connections
 - LED and its connections
 - Tri-color LED
 - Resistor
 - Simple circuit using LED, resistor and breadboard
 - Common mistakes when using breadboard to make connections
 - Pushbutton and its connections
 - Common mistakes when using pushbutton to make connections
 - Seven segment display and its connections
 - Demonstration of all the above components
3. Introduction to Arduino
 - About Arduino device
 - Features of Arduino
 - Components of Arduino board
 - Description of Microcontrollers
 - Few examples where a Microcontroller is used
 - Installation of Arduino IDE on Ubuntu Linux OS
 - Run the arduino executable file
 - The Arduino IDE window
4. Arduino components and IDE
 - Set up a physical connection between Arduino and a computer
 - Connect the Arduino board to the computer using the USB cable
 - Various components available in Arduino hardware

- ATMEGA 328 microcontroller chip
 - About Arduino BootLoader
 - Digital Pins
 - Analog Pins
 - Blinking LEDs that are helpful for troubleshooting
 - Ground Pins
 - External power adapter
 - Arduino programming language
5. First Arduino Program
- Write an Arduino program to blink an LED
 - Arduino program is saved as Sketch
 - Default program environment with two empty functions -
 - setup - function for setting up a micro-controller
 - loop - infinite loop
 - Program to turn on the LED
 - Compile the program into binary format
 - Program to turn off the LED
6. Arduino with Tricolor LED and Push button
- Tricolor LED - Common Cathode Tricolor LED
 - Other external devices that are required for this experiment
 - Understand the connection circuit details
 - Connect a tricolor LED to Arduino board
 - Write a program to blink tricolor LED
 - Use Pushbutton to control the blinking
 - How to reduce the delay of the blink
7. Arduino with LCD
- Connect an LCD to Arduino board
 - See the details of the circuit connection
 - See how to do the soldering
 - Setup the components as per the circuit diagram
 - The aim is to write two strings on the LCD display
 - Write a program to display a text message on the LCD
8. Display counter using Arduino
- Connect an LCD and a Push button to Arduino board.
 - Add a pushbutton and make a simple counter
 - Write a program in the Arduino IDE
 - See that pushbutton is working successfully
 - Modify the program to set a counter

- Output: count is increased whenever the button is pressed

9. Seven Segment Display

- Connect a seven segment display to Arduino board
- Types of seven segment display
- Connection details of common cathode seven segment display
- Connection details of common anode seven segment display
- Circuit connection explanation
- Live setup of the connection
- Program to blink LEDs in seven segment display
- High and low state of LED's in the seven segment
- Program to display digits 0 to 4 in seven segment display
- Compile and upload the program

10. Pulse Width Modulation

- About Pulse Width Modulation
- About duty cycle and frequency
- Formula to calculate the duty cycle
- Experiment to control the brightness of LED by varying the duty cycle
- Experiment to control the speed and direction of a DC motor
- Circuit connection explanation of the above experiments
- Source code for the above experiments
- Demonstration of the output

11. Analog to Digital Conversion

- About DHT11 sensor
- Arduino resolution concepts
- Circuit connection details of DHT11 sensor and Arduino
- Features of DHT11
- Download the DHT11 Arduino library to run this program.
- Code to detect the temperature and humidity using DHT11 sensor
- Display the output in the Serial Monitor screen
- Display the output in the Serial Plotter screen

12. Wireless Connectivity to Arduino

- About ESP8266-01 WiFi module
- Various pins of ESP8266-01 WiFi module
- Circuit connection of ESP8266 - 01 module with Arduino
- Setup the read-write permission to the USB port
- Download and install ESP8266 WiFi module in Arduino IDE
- Establish a connection between WiFi module and a laptop or a mobile phone
- Source code for the above experiment

- Demonstration of the output

Intermediate Level

1. Assembly of Robot

- Components required to build a Robot
- About soldering DC motors
- Acrylic Robot Chassis with screws and nuts
- Steps to mount the motor on the Chassis
- Fixing the wheels of the Robot
- Assembled Robot
- About .apk file
- About MIT App inventor to build an app
- Code file for Car Bluetooth RC.apk
- Steps to install the app on the Android phone

2. Robot Control using Bluetooth

- Components required for Bluetooth communication
- About Bluetooth communication
- About Data Mode and AT Command Mode
- Circuit connection details of Arduino board and HC-05 Bluetooth module
- Actual setup of the connections
- Program to control the movement of the Robot
- Configure the Bluetooth in Android phone
- Working of the Car Bluetooth RC App
- Working of the Robot
- Control the movement of the Robot using Bluetooth communication

3. Introduction to IoT

- About IoT
- IoT system components
- About Thingspeak platform
- Create an account in Thingspeak
- Login to the account and create a new channel
- Enter the channel information
- Show the graph outline
- Generate the API keys
- Importance of Write API key and Read API key
- Copy the Write API key

4. Sending data to the cloud using IoT devices

- External components required for sending data to the cloud
- About MQTT Protocol
- Circuit connection of DHT11 and WiFi module with Arduino
- Setup the MB102 module on Breadboard
- Circuit connections required for the experiment
- Configure the ESP8266 module to communicate
- Download a DHT sensor library
- Program in Arduino IDE for interfacing WiFi module and DHT11 sensor
- Working of ThingSpeak channel
- Graph of temperature and humidity values from the DHT11 sensor in ThingSpeak platform
- Data Import/Export option to download the data as CSV file

Advance Level

1. Assembly programming through Arduino

- Write an assembly program to display a digit on seven segment display
- Arduino - Assembly code reference
- Arduino ATmega328 Pin mapping
- Connection circuit details
- Installing AVRA and AVRDUDE assembler
- How to connect and check the port number of Arduino
- Assembly program to glow the dot LED on the seven segment display
- Assembly program to display digit two on the seven segment display
- Assembly program to display digit five on the seven segment display using decoder
- How to save the file, assemble and upload to the Arduino

2. Digital Logic Design with Arduino

- Write an assembly to verify the logical AND operation
- Use the m328Pdef.inc file that is available in the code files link of this tutorial.
- Explanation of the Source code for logical AND operation
- Save the file and generate the.hex file
- Upload the code to the Arduino
- Displaying the output on the Seven segment display
- Replace the program with or to perform logical OR operation
- Replace the program with xor to perform logical XOR operation
- Implement and verify the below combinational logics:
 - $A = W'$

- $B = WX'Z' + W'X$
- $C = WXY' + X'Y + W'Y$
- $D = WXY + W'Z$

3. AVR-GCC programming through Arduino

- Write an assembly program to display a digit on seven segment display
- Arduino - Assembly code reference
- Arduino ATmega328 Pin mapping
- Connection circuit details
- Installing AVRA and AVRDUDE assembler
- How to connect and check the port number of Arduino
- Assembly program to glow the dot LED on the seven segment display
- Assembly program to display digit two on the seven segment display
- Assembly program to display digit five on the seven segment display using decoder
- How to save the file, assemble and upload to the Arduino

4. Interfacing LCD through AVR-GCC programming

- Interface a LCD to Arduino board
- Pin connections details of the Arduino and LCD
- Image showing the connections
- Live set up of the connections
- Write an AVR-GCC program to display a digit on LCD
- Using avr/io.h, util/delay.h, stdlib.h libraries in the program
- Using ClearBit() and SetBit() function
- Various functions used to excute the output
- Using make FNAME command to compile and upload to Arduino
- Displaying the output digit 5 on the LCD

5. Mixing Assembly and C programming

- Combining Assembly and C programming
- Explanation of the circuit connections
- Live setup of the connection
- Assembly routine program which initialises and sets pin 13 of Arduino as output
- Call that Assembly routine in AVR-GCC program to blink the Dot LED of the Seven Segment display
- Use the Makefile that is available in the code files link of this tutorial.
- Explanation of the Source code of the subroutine and main program
- Save the file and generate the .hex file
- Upload the code to the Arduino

- Display the output on the Seven segment display

6. Getting Ready for Arduino FLOSS

- About FLOSS Arduino website
- Download the e-book and code files from the FLOSS Arduino website
- About Arduino Shield
- About tools and user code
- About various experiments used in the e-book
- Upload a program in Arduino IDE to check the working of the shield
- About FLOSS Firmware
- Why do we need FLOSS Firmware?
- Upload the FLOSS firmware to the Arduino Uno board
- Important points to remember

7. Arduino Programming with Scilab and Xcos

- About Getting ready for Arduino FLOSS tutorial
- Refer to chapter 3 of the e-book for installation of Arduino IDE and Scilab
- Points to be noted before proceeding
- Interfacing Arduino with Scilab
- About Arduino-Scilab toolbox
- Set the Scilab working directory to the toolbox folder
- Run the scilab script to check whether the firmware is properly installed or not
- Scilab program to read the status of the pushbutton and display it on the GUI
- Xcos program to turn the LED on or off, depending on the pushbutton status
- Important points to remember

8. Arduino Programming with Python

- About Getting ready for Arduino FLOSS tutorial
- Refer to chapter 3 of the e-book for installation of Arduino IDE and Python
- Points to be noted before proceeding
- Interfacing Arduino with Python
- About Arduino-Python toolbox
- Run the Python script to check whether the firmware is properly installed or not
- Python program for Interfacing a Light Emitting Diode.
- Program to turn on blue LED
- Output of the experiment
- Important points to remember

9. Arduino Programming with Julia

- About Getting ready for Arduino FLOSS tutorial
- Refer to chapter 3 of the e-book for installation of Arduino IDE and Julia
- Points to be noted before proceeding
- Interfacing Arduino with Python
- About Arduino-Julia toolbox
- How to execute Julia test_firmware.jl
- Julia program for Interfacing a Potentiometer
- Program to turn on LEDs depending on the potentiometer threshold
- Output of the experiment
- Important points to remember

10. Arduino Programming with OpenModelica

- About Getting ready for Arduino FLOSS tutorial
- Refer to chapter 3 of the e-book for installation of Arduino IDE and OpenModelica
- Points to be noted before proceeding
- Interfacing Arduino with OpenModelica
- About Arduino-OpenModelica toolbox
- Load the Arduino OpenModelica toolbox
- OpenModelica program for interfacing a thermistor
- Program to read and display the thermistor values
- Output of the experiment
- Important points to remember

List of students enrolled

1	SHAMIM	BANU
2	SHARAD	GUPTA
3	SHUBHAM	DALAL
4	VAIBHAV	SARRAF
5	VISHNU	KUMAR
6	ABHINAV	KANCHHAL
7	ABHISHEK	GUPTA
8	ADITI	SHARMA
9	AKSHAY	BAID
10	AMAN	RAWAT
11	ANSH	ARORA
12	ANSHUL	KOTHARI
13	ARPIT	DADHEECH
14	ARYAN	AGARWAL
15	ATUL	GAUR
16	MOHIT	GUPTA
17	RAHUL KUMAR	LOVEWANSI

18	RISHABH	RANA
19	RISHIKA	JAIN
20	AAMOD	MATHUR
21	AJAT	PAREEK
22	ANMOL	BAJAJ
23	ANNU	PRIYA
24	ASHISH	PAREEK
25	OPAL	MISHRA
26	PRAVEEN MALIK	MALIK
27	RAVI	SHARMA
28	RITIKA	GUPTA
29	SARTHAK	CHAUHAN
30	SAURABH	SHARMA
31	SHANKAR	KUMAR
32	SHASHANK	MATHUR
33	SHASHANK	SHARMA
34	SHAURYA	DIXIT
35	HARIOM	SHARMA
36	VAIBHAV	JAIN
37	ANUKRATI	BANSAL
38	MITANSHU	GUPTA
39	SAHIL	KHAN
40	AJAY	AGARWAL
41	VIPUL	JAIN