

# CURRICULUM OF “INTERNET OF THINGS”

Dec 2021



**National Vocational & Technical  
Training Commission**

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# Introduction

## **Definition/ Description of the training programme for *Internet of Thing***

The Internet of Things (IoT) is a network of resource constrained nodes being capable of automating an existing manual procedure.

## **Purpose of the training programme**

The IoT programme is to engage young people with a programme of development that will provide them with the knowledge, skills and understanding to start this career in Pakistan. The specific objectives of developing these qualifications are as under:

- Improve the professional competence of the trainees
- Provide opportunities for recognition of skills attained through non-formal or informal pathways
- Improve the quality and effectiveness of training and assessment for IoT industry

## **Overall objectives of training programme**

The overall objectives of the IoT program are producing skilled staff to:

- Develop software
- Develop mobile application
- Network & communication support assistant
- IoT program assistant

## **Competencies to be gained after completion of course**

- Interface Sensors and Actuators
- Apply Microcontroller interfacing protocols
- Configure ADC of a Controller
- Configure PWM Outputs of a controller
- Identify and interface Short Range Wireless Technologies (Wifi, Bluetooth, RFID, Zigbee, BLE) with the microcontrollers
- Program Basic Building blocks using C/C++
- Program different applications in Arduino, NodeMCU, Raspberry Pi
- Perform Arduino, NodeMCU, Raspberry Pi interfacing with Sensors
- Perform Socket Programming
- Develop mobile apps using MIT APP Inventor
- Develop a smart home based project
- Work in a Team

## **Trainee entry level**

The entry requirement for this qualification would be Matric with science with Level 3 Certificate of IoT. Age 18 years or above

## **Minimum qualification of trainer**

Teaching staff qualification should be BS (EE) with specialization in computer, BS (Computer Engineering, Computer Science, Software Engineering, I.T, Computer Networks, Cyber security, Data Science, and IOT) or equivalent.

## **Recommended trainer: trainee ratio**

The recommended maximum trainer: trainee ratio for this programme is 1 trainer for 25 trainees.

## **Medium of instruction i.e. language of instruction**

Instruction will be Urdu and English.

## **Duration of the course (Total time, Theory & Practical time)**

This curriculum comprises 11 module. The recommended delivery time is 1200 hours. Delivery of the course could therefore be full time, 5 days a week, for 12 months. Training providers are at liberty to develop other models of delivery, including part-time and evening delivery.

The full structure of the course is as follow:

<b>Module Level-4</b>	<b>Theory<sup>1</sup> Days/hours</b>	<b>Workplace<sup>1</sup> Days/hours</b>	<b>Total hours</b>
<b>Module 1</b> Interface Sensors and Actuators	28	69	97
<b>Module 2</b> Apply Microcontroller interfacing protocols	18	69	87
<b>Module 3</b> Configure ADC & PWM of a Controller	15	42	57
<b>Module 4</b> Identify and interface Short Range Wireless Technologies (Wifi, Bluetooth, RFID, Zigbee, BLE) with the microcontrollers	22	96	118
<b>Module 5</b> Program Basic Building blocks using C/C++	52	246	298
<b>Module 6</b> Program different applications in Arduino, NodeMCU, Rasberry Pi	22	81	103
<b>Module 7</b> Perform Arduino, NodeMCU, Rasberry Pi interfacing with Sensors	26	90	116
<b>Module 8</b> Perform Socket Programming	19	87	106
<b>Module 9</b> Develop mobile apps using MIT APP Inventor	19	96	115
<b>Module 10</b> Develop a smart home based project	7	66	73
<b>Module 11</b> Work in a team	12	18	30

## Summary – overview of the curriculum

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
<b>Module 1</b> Interface Sensors and Actuators  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Interface Sensors and Actuators	<b>LU1.</b> Interface Temperature Sensor <b>LU2.</b> Interface Humidity Sensor <b>LU3.</b> Interface Occupancy Sensor <b>LU4.</b> Interface IR Sensor <b>LU5.</b> Interface Ultrasonic Sensor <b>LU6.</b> Interface RFID <b>LU7.</b> Interface NFC <b>LU8.</b> Interface Actuators	28	69	97
<b>Module 2</b> Apply microcontroller interfacing protocols  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Apply microcontroller interfacing protocols	<b>LU1.</b> Connect and read data through SPI Interface <b>LU2.</b> Connect and read data through I2C Interface <b>LU3.</b> Connect and read data through Serial Communication (UART, USART) <b>LU4.</b> Connect and read data through RS232	18	69	87

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
<b>Module 3</b> Configure ADC and PWM of a Controller  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to : Configure ADC of a Controller	<b>LU1.</b> Configure ADC of Arduino and NodeMCU <b>LU2.</b> Configure PWM of Arduino/NodeMCU <b>LU3.</b> Configure ADC of Raspberry Pi	15	42	57
<b>Module 4</b> Identify and interface short range wireless technologies (WiFi, BlueTooth,BLE, RFID, Zigbee) with Micro-controller  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Identify and interface short range wireless technologies (WiFi, BlueTooth,BLE, RFID, Zigbee) with Micro-controller	<b>LU1.</b> Interface WiFi module with a Controller <b>LU2.</b> Interface Bluetooth module with a controller <b>LU3.</b> Interface ZigBee with a controller	22	96	118

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
<b>Module 5</b> Program Basic Building Blocks using C/  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Program Basic Building Blocks using C/	<b>LU1.</b> Develop Basic program with Arithmetic Computations <b>LU2.</b> Develop Basic program with Decision control <b>LU3.</b> Develop Basic programs using loop <b>LU4.</b> Develop programs with arrays <b>LU5.</b> Develop programs using pointer <b>LU6.</b> Develop program with functions <b>LU7.</b> Develop a program using built-in libraries <b>LU8.</b> Develop programs using basic classes <b>LU9.</b> Develop programs using encapsulation <b>LU10.</b> Develop program using classes with inheritance <b>LU11.</b> Develop program using classes with polymorphism <b>LU12.</b> Develop program using files	52	246	298
<b>Module 6</b> Program different applications in Arduino, Raspberry Pi and NodeMCU  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Program different applications in Arduino, Raspberry Pi and NodeMCU	<b>LU1.</b> Program different application in Arduino <b>LU2.</b> Program different application in Raspberry Pi <b>LU3.</b> Program different application in NodeMCU	22	81	103



Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
<b>Module 7</b> Perform Arduino, Raspberry Pi and NodeMCU interfacing with sensors  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to	<b>LU1.</b> Perform Arduino interfacing with sensors <b>LU2.</b> Perform Raspberry Pi interfacing with sensors <b>LU3.</b> Perform NodeMCU interfacing with sensors	26	90	116
<b>Module 8</b> Perform Socket Programming  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Perform Socket Programming	<b>LU1.</b> Develop the code to communicate between client and server side <b>LU2.</b> Develop the code for multi-client server	19	87	106
<b>Module 9</b> Develop mobile apps using MIT APP inventor  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to Develop mobile apps using MIT APP inventor	<b>LU1.</b> Set-up MIT app inventor Programming Environment <b>LU2.</b> Transfer app to mobile device via USB and WIFI <b>LU3.</b> Develop Basic app with user interface <b>LU4.</b> Develop app with multi-screen <b>LU5.</b> Develop app to interact with phone Call <b>LU6.</b> Develop app to interact with location sensor <b>LU7.</b> Develop app to transmit data to local Database <b>LU8.</b> Install App Inventor support for Arduino	19	96	115

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
<b>Module 10</b> Develop a Smart Home Project  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to develop a smart home project	<b>LU1.</b> Control Lights and Fans through Android Application <b>LU2.</b> Receive Indoor sensor's value on android app	7	66	73
<b>Module 11</b> Work in a Team  <b>Aim:</b> The aim of this module to develop advanced knowledge, skills and understanding to work in a team	<b>LU1.</b> Obtain and convey Workplace information <b>LU2.</b> Participate in workplace meetings and discussions <b>LU3.</b> Identify own role and responsibility within team <b>LU4.</b> Support the co-workers	12	18	30

## LEVEL 4

### Module 1 : Interface Sensors and Actuators

**Objective of the module:** This competency unit covers the skills and required knowledge to interface (connect physically) different sensors and actuators in the given circuit.

<b>Duration:</b>	97 hours	<b>Theory:</b>	21 hours	<b>Practical:</b>	69 hours	
Learning Unit	• Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place	
<b>LU1:</b> Interface Temperature Sensor	<b>Trainee will be able to:</b> <ul style="list-style-type: none"><li>• Select sensor according to specification</li><li>• Download the datasheet to configure pins</li><li>• Configure sensor according to datasheet</li><li>• Connect the sensor in the given circuit</li></ul>	<ul style="list-style-type: none"><li>• Knowledge of different types of sensors</li><li>• Knowledge of measurement system specification</li><li>• Understanding of sensor identification number</li><li>• Explain and differentiate kinds of transducing principles for temperature measurements</li><li>• </li><li>• Download and explore technical datasheet of the selected sensor</li><li>• Process to interface / connect temperature sensor</li><li>• Differentiate power, communication and control pins</li><li>• Understanding of communication protocol</li><li>• Method to select exact sensor for different ranges of temperature</li><li>• Explain communication protocols for relevant sensor connectivity</li></ul>	<b>Total:</b> 12 hrs <b>Theory:</b> 03 hr <b>Practical:</b> 09 hr	<b>Consumable</b> <ul style="list-style-type: none"><li>• Notebooks</li><li>• Pencils</li><li>• Erasers</li><li>• Sharpeners</li></ul> <b>Non Consumable</b> <ul style="list-style-type: none"><li>• Temperature Sensor</li><li>• Internet</li><li>• Computer</li><li>• Multimedia projector</li><li>• Instructional manual</li><li>• Arduino</li></ul>	Class room, Lab.	

		<ul style="list-style-type: none"> <li>Read and record the values obtained from different sensors</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to interface temperature sensor with Arduino board and display the temperature reading on Arduino software display</li> <li>Practice to find the resolution and sensitivity of sensor</li> </ul>		<ul style="list-style-type: none"> <li>Data sheet</li> </ul>	
<b>LU2:</b> Interface Humidity Sensor	<p><b>Trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>Select sensor according to specification</li> <li>Download the datasheet to configure pins</li> <li>Configure sensor according to datasheet</li> <li>Connect the sensor in the given circuit</li> </ul>	<ul style="list-style-type: none"> <li>Understanding of sensor identification number</li> <li>Process to download and explore technical datasheet for the selected sensor</li> <li>Knowledge of Interfacing / connecting humidity sensor</li> <li>Technique to select exact sensor for different humidity environments</li> <li>Differentiate power, communication and control pins</li> <li></li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to interface humidity sensor with Raspberry Pi board and display on screen</li> </ul>	<p><b>Total</b></p> <p>08 hrs</p> <p><b>Theory:</b></p> <p>02 hr</p> <p><b>Practical:</b></p> <p>06 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>White board</li> <li>Multimedia</li> <li>Humidity Sensor</li> <li>Internet</li> <li>Computer</li> <li>Raspberry Pi</li> </ul>	Class room, Lab.

<b>LU3: Interface Occupancy Sensor</b>	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Select sensor according to specification</li> <li>• Download the datasheet to configure pins</li> <li>• Configure sensor according to datasheet</li> <li>• Connect the sensor in the given circuit</li> </ul>	<ul style="list-style-type: none"> <li>• Explain and differentiate kinds of transducing principles and sensors for occupancy and motion sensors</li> <li>• Applications of Occupancy sensors</li> <li>• Understanding of sensor identification number</li> <li>• Explore technical datasheet of the selected sensor</li> <li>• Knowledge of Interfacing / connecting occupancy sensor</li> <li>• Select exact sensor type for different locations / environments</li> <li>• Understanding functionality of different pins of sensors</li> <li>• Explain communication protocols for relevant sensor connectivity</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to interface occupancy sensor with Arduino board and display the output using 7 segment display</li> </ul>	<b>Total</b> 12 hrs  <b>Theory:</b> 03 hr  <b>Practical:</b> 09 hrs	<div>Consumable</div> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <div>Non Consumable</div> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Occupancy Sensor</li> <li>• Internet</li> <li>• Computer system</li> <li>• Arduino</li> <li>• 7 segment display</li> </ul>	Class room, Lab.
<b>LU4: Interface IR Sensor</b>	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Select sensor according to specification</li> <li>• Download the datasheet to configure pins</li> <li>• Configure sensor according to datasheet</li> </ul>	<ul style="list-style-type: none"> <li>• Explain and differentiate kinds of transducing principles and sensors for IR sensors</li> <li>• Understanding of sensor identification number</li> <li>• Explore technical datasheet of the selected sensor</li> <li>• Applications of IR Sensors</li> </ul>	<b>Total</b> 14 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b>	<div>Consumable</div> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul>	Class room, Lab.

	<ul style="list-style-type: none"> <li>• Connect the transmitter in the circuit</li> <li>• Connect the receiver in the circuit.</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of Interfacing / connecting IR sensor</li> <li>• Understanding to select exact sensor type for different locations / environments</li> <li>• Understanding functionality of different pins of sensors</li> <li>• Explain communication protocols for relevant sensor connectivity</li> <li>• Understanding of anode and cathode in sensor</li> <li>• Understanding of emitter and collector in sensor</li> <li>• Knowledge of active or passive sensor</li> <li>• Understanding of transmitter and receiver</li> <li>• Process to install sensor in designed circuit</li> <li>• Process to install transmitter and receiver in line-of-sight</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to interface occupation sensor with Arduino board and detect motion in room and display on Arduino</li> </ul>	09 hrs	<div>Non</div> <div>Consumable</div> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• IR Sensor</li> <li>• Internet</li> <li>• Computer system</li> </ul>	
<b>LU5.</b> Interfac	<b>Trainee will be able to:</b>	<ul style="list-style-type: none"> <li>• Explain and differentiate kinds of transducing principles and sensors for ultrasonic sensors</li> </ul>	<b>Total</b>	<div>Consumable</div> <ul style="list-style-type: none"> <li>• Notebooks</li> </ul>	Class room,

e Ultrasonic Sensor	<ul style="list-style-type: none"> <li>• Select sensor according to specification</li> <li>• Connect the Vcc and GND with respective pins of circuit</li> <li>• Connect ECHO pin with RX pin of your circuit</li> <li>• Connect TRIG pin with TX pin of circuit.</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of sensor identification number</li> <li>• Explore technical datasheet of the selected sensor</li> <li>• Know the applications of ultrasonic Sensors</li> <li>• Knowledge of Interfacing / connecting ultrasonic sensor</li> <li>• Process to identify exact sensor type for different locations / environments</li> <li>• Understanding functionality of different pins of sensors</li> <li>• Explain communication protocols for relevant sensor connectivity</li> <li>• Understanding of anode and cathode in sensor</li> <li>• Understanding of emitter and collector in sensor</li> <li>• Understanding of transmitter and receiver in line-of-sight</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to interface ultrasonic sensor with Arduino board and control the fan at the output of Arduino</li> </ul>	<p>14 hrs</p> <p><b>Theory:</b></p> <p>04 hrs</p> <p><b>Practical:</b></p> <p>09 hrs</p>	<ul style="list-style-type: none"> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p>Non Consumable</p> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• IR Sensor</li> <li>• Internet</li> <li>• Computer system</li> <li>• Arduino</li> <li>• Fan</li> </ul>	Lab.
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<b>LU 6: Interface RFID</b>	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Select sensor according to specification</li> <li>• Download the datasheet to configure pins</li> <li>• Configure sensor according to datasheet</li> <li>• Connect the sensor in the given circuit</li> </ul>	<ul style="list-style-type: none"> <li>• Identify three components of RFID (RFID reader, RFID antenna, RFID transponder (tag))</li> <li>• Application of RFID</li> <li>• Explain and differentiate kinds of transducing principles and sensors for RFID sensors</li> <li>• understanding of sensor identification number</li> <li>• Download and explore technical datasheet of the selected sensor</li> <li>• Knowledge of Interfacing / connecting RFID tags, reader &amp; antenna.</li> <li>• Knowledge of basic RFID classes for Passive and Active RFIDs</li> <li>• Powering up active RFID with batteries</li> <li>• Differentiate Data and excitation pins</li> <li>• Select exact sensor type for different objects / environments</li> <li>• Understanding functionality of different pins of sensors</li> <li>• Explain communication protocols for relevant sensor connectivity</li> <li>• Understanding of anode and cathode in sensor</li> <li>• Installation process of RFID tags in objects according to designed circuit</li> </ul>	<b>Total</b> 17 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 12 hrs	<div>Consumable</div> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <div>Non Consumable</div> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• RFID tags</li> <li>• RFID reader</li> <li>• RFID antennas</li> <li>• Internet</li> <li>• Computer system</li> <li>• Arduino/Raspberry Pi</li> <li>• 7segment display</li> </ul>	Class room, Lab.
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		<ul style="list-style-type: none"> <li>Understanding of reader and antenna and receiver readings</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to display student information on 7 segment display using RFID sensor</li> </ul>			
<b>LU 7:</b> Interface NFC	<p><b>Trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>Select sensor according to specification</li> <li>Download the datasheet to configure pins</li> <li>Configure sensor according to datasheet</li> <li>Connect the sensor in the given circuit</li> </ul>	<ul style="list-style-type: none"> <li>Define near field communication (NFC)</li> <li>Know the usage of NFC</li> <li>Explain different components of NFC</li> <li>Explain straightforward tap-and-go mechanism to connect two different IoT devices</li> <li>Differentiate active and passive NFC systems and devices</li> <li>NFC applications in smart phones</li> <li>Mechanism of NFC tags embedded in labels or smart posters</li> <li></li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to enable smartphone WiFi using NFC tag</li> </ul>	<p><b>Total</b></p> <p>09 hrs</p> <p><b>Theory:</b></p> <p>03 hrs</p> <p><b>Practical:</b></p> <p>06 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <p><b>Non</b></p> <p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>White board</li> <li>Multimedia</li> <li>NFC tag</li> <li>Internet</li> <li>Computer system</li> <li>Smartphone</li> </ul>	Class room, Lab.
<b>LU 8:</b> Interface Actuators	<p><b>Trainee will be able to:</b></p>	<ul style="list-style-type: none"> <li>Define actuator</li> </ul>	<p><b>Total</b></p> <p>14 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Notebooks</li> </ul>	Class room, Lab.

	<ul style="list-style-type: none"> <li>• Select actuator according to specification</li> <li>• Download the datasheet to configure pins</li> <li>• Configure actuator according to datasheet</li> <li>• Connect the actuator with corresponding digital/analog pin</li> </ul>	<ul style="list-style-type: none"> <li>• Explain basic functions of actuator</li> <li>• Describe different types of actuators present in various devices like servo motor, stepper motor, DC motors, linear actuator, relay, and solenoid</li> <li>• Process of using triacs for AC switching</li> <li>• Process of using SCR</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to run a DC motor using relay circuit</li> </ul>	<p><b>Theory:</b></p> <p>05 hrs</p> <p><b>Practical:</b></p> <p>09 hrs</p>	<ul style="list-style-type: none"> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p>Non Consumable</p> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Actuators</li> <li>• IR Sensor</li> <li>• Internet</li> <li>• Computer system</li> <li>• Relay</li> <li>• DC motor</li> </ul>	
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## Module 2 : Apply microcontroller interfacing protocols

**Objective of the module:** This competency unit covers the skills and required knowledge to apply microcontroller interfacing protocols.

<b>Duration:</b>	87 hours	<b>Theory:</b>	18 hours	<b>Practical:</b>	69 hours
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Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
<b>LU1:</b> Connect and read data through SPI Interface	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>Select number of pins as per requirement</li> <li>select number of packets and its format</li> <li>Create the packets in sequence in C programming language</li> <li>Connect the sensor in the circuit using SPI interface</li> <li>read value in C programming language</li> </ul>	<ul style="list-style-type: none"> <li>Working knowledge of Serial Peripheral Interface (SPI)</li> <li>Define half / full duplex communication</li> <li>Differentiate data, clock and excitation pins</li> <li>Working knowledge of Modes, Clock speed, data rate and length limit of SPI components</li> <li>Explain pins function</li> <li>Explain packet format</li> <li>Knowledge of C language for interfacing devices</li> <li>Physically connecting the sensors and get output reading</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to connect the sensor in the circuit using this interface and read value in C programming language</li> </ul>	<b>Total:</b> 26 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 18 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Microcontroller</li> <li>Internet</li> <li>Computer</li> <li>Multimedia projector</li> <li>Instructional manual</li> <li>C IDE</li> <li>Trainer</li> </ul>	Class room , Lab
<b>LU2:</b>	<b>Trainee will be able to:</b>	<ul style="list-style-type: none"> <li>Define i2c serial protocol</li> <li>Define i2c serial interfaces</li> </ul>	<b>Total:</b>	<b>Consumable</b>	Class room,

Connect and read data through I2C Interface	<ul style="list-style-type: none"> <li>Select number of pins as per requirement</li> <li>select number of packets and its format</li> <li></li> <li>Create the packets in sequence in C programming language</li> <li>Connect the sensor in the circuit using I2C interface of microcontroller</li> <li>Read value in C programming language</li> </ul>	<ul style="list-style-type: none"> <li>Define synchronous and asynchronous communication</li> <li>Explain i2c clock speed, devices and working voltage</li> <li>Process of connecting the sensors and get output reading</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to connect the sensor in the circuit using I2C interface and read and write value in C programming language and display it on 7 segment screen</li> </ul>	21 hrs <b>Theory:</b> 05 hrs <b>Practical:</b> 18 hrs	<ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>White board</li> <li>Microcontroller</li> <li>Multimedia</li> <li>Internet</li> <li>Computer system</li> <li>C IDE</li> <li>Trainer</li> </ul>	Lab.
<b>LU3:</b> Connect and read data through Serial Communication (UART, USART)	<p><b>Trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>Select number of pins as per requirement</li> <li>Select number of packets and its format</li> <li>Create the packets in sequence in C programming language</li> <li>Connect the sensor in the circuit using UART, USART interface</li> <li>Read value in C programming language</li> </ul>	<ul style="list-style-type: none"> <li>Define UART &amp; USART serial protocol</li> <li>Define UART &amp; USART serial interfaces</li> <li>Explain UART &amp; USART clock speed, devices, baud rate and working voltage</li> <li>Process of connecting the sensors and get output reading</li> </ul> <p><b>Practical Activity:</b></p>	<b>Total:</b> 25 hrs <b>Theory:</b> 05 hrs <b>Practical:</b> 18 hrs	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>White board</li> <li>Microcontroller</li> <li>Multimedia</li> </ul>	Class room, Lab.

		<ul style="list-style-type: none"> <li>Practice to write a micro C program transmit character “A” continuously with baud rate 9600 and XTAL=10 Mhz</li> <li>Practice to write a micro C program throw serially received data to port B continuously with baud rate 9600 and XTAL=10 Mhz</li> </ul>		<ul style="list-style-type: none"> <li>Internet</li> <li>Computer system</li> <li>C IDE</li> <li>Trainer</li> </ul>	
<b>LU4:</b> Connect and read data through RS232	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>Select number of pins as per requirement</li> <li>Select number of packets and its format</li> <li>Create the packets in sequence in C programming language</li> <li>Connect the sensor in the circuit using RS232 interface</li> <li>Read value in C programming language</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Define RS232serial protocol</li> <li>Define RS232 serial interfaces</li> <li>Explain RS232 clock speed, devices and working voltage</li> <li>Process of connecting the sensors and get output reading</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to write a micro C program transmit character “Pakistan” continuously with baud rate 9600 and XTAL=10 Mhz</li> </ul>	<b>Total:</b> 22 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 15 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>White board</li> <li>Microcontroller</li> <li>Multimedia</li> <li>Internet</li> <li>Computer system</li> <li>C IDE</li> </ul>	Class room

### Module 3 : Configure ADC and PWM of a Controller

**Objective of the module:** This competency unit covers the skills and required knowledge to configure ADCs and configure PWM available on microcontrollers.

<b>Duration:</b>	91 hours	<b>Theory:</b>	22 hours	<b>Practical:</b>	69 hours
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Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
<b>LU1:</b> Configure ADC of Arduino and NodeMCU	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>Download datasheet of required module</li> <li>Select ADC pins</li> <li>Calculate Resolution of ADC</li> <li>Make one ADC pin as input using C/C++ programming language</li> <li>Write and read value in C/C++ programming language</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge of downloading datasheet for Arduino</li> <li>Explain functionality of Analog to Digital Converter (ADC)</li> <li>Knowledge of working resolutions for ADC</li> <li>Configure ADC pins as input pin using C/C++ language</li> <li>View and record value</li> <li>Explain microchips</li> <li>Explain ROM, EPROM, EEPROM</li> <li>Knowledge of downloading NDeMCU and ESP datasheets</li> <li>Functions of ADC pins</li> <li>Working knowledge of NodeMCU wireless module</li> <li>Working knowledge of ESP wireless module</li> <li>Basic knowledge of C/C++ language for hardware configuration</li> </ul>	<b>Total:</b> 26 hrs  <b>Theory:</b> 06 hrs  <b>Practical:</b> 21 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>White board</li> <li>Arduino</li> <li>ADC</li> <li>Multimedia</li> <li>Internet</li> <li>Computer system</li> <li>NodeMCU module</li> </ul>	Class room, Lab.

		<b>Practical Activity:</b> <ul style="list-style-type: none"> <li>Practice to write a C/C++ program to get data from a channel of ADC and display the sample result on different ports of controller this is done after every quarter of second</li> </ul>			
<b>LU2:</b> Configure PWM of Arduino/NodeMCU	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>Download datasheet of Arduino/NodeMCU</li> <li>Select Analog pins</li> <li>Calculate Resolution of ADC</li> <li>Make one ADC pin as output using C</li> <li>Connect LED to this Pin</li> <li>Examine LEDs brightness</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge of downloading datasheets of Arduino / NodeMCU</li> <li>Identification process of analog pins of device</li> <li>Method of configuring a pin as output pin using C language</li> <li>Process of connecting LED to output pin</li> <li>Observe and note output displayed on LED</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>Practice to write a C/C++ program to create PWM with 75% duty cycle frequency <math>f=2.5\text{kHz}</math>, XTAL=10Mhz</li> </ul>	<b>Total:</b> 32 hrs  <b>Theory:</b> 08 hrs  <b>Practical:</b> 24 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Temperature Sensor</li> <li>Internet</li> <li>Computer</li> <li>Multimedia projector</li> <li>Instructional manual</li> <li>Arduino</li> </ul>	Class room, Lab.

				<ul style="list-style-type: none"> <li>• ADC module</li> <li>• LEDs</li> <li>• NodMCU module</li> <li>• Trainer</li> </ul>	
<b>LU3:</b> Configure ADC of Raspberry Pi	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Download Pin Configuration of Raspberry Pi</li> <li>• Select PWM pins</li> <li>• Set identified pin as output in</li> <li>• Set frequency of required signal</li> <li>• Apply this frequency on this output pin using</li> <li>• Connect LED to identified pin</li> <li>• Examine LEDs brightness</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of downloading Pin configuration for Raspberry Pi boards</li> <li>• Identify PWM pins</li> <li>• Basic knowledge of language for hardware configuration</li> <li>• Process of configuring selected pin as output pin using</li> <li>• Process of configuring frequency on output pin using</li> <li>• Observe and note output displayed on LED</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to turn on and off fan for 30 second duration each using relay switch</li> </ul>	<b>Total:</b> 32 hrs  <b>Theory:</b> 08 hrs  <b>Practical:</b> 24 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Temperature Sensor</li> <li>• Internet</li> <li>• Computer</li> <li>• Multimedia projector</li> <li>• Instructional manual</li> <li>• ADC module</li> </ul>	Class room, Lab.



				<ul style="list-style-type: none"> <li>• Raspberry Pi module</li> <li>• Trainer</li> </ul>	
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## Module 4 : Identify and Interface Short Range Wireless Technologies (WiFi, BlueTooth, BLE, RFID, Zigbee) with Micro-controller

**Objective of the module:** This competency unit covers the skills and required knowledge to use different Short-Range Wireless Technologies such as (WiFi, BlueTooth, BLE, RFID, Zigbee). This competency unite also covers the tools required to execute the performance criterion.

<b>Duration:</b>	118 hours	<b>Theory:</b>	22 hours	<b>Practical:</b>	96 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
<b>LU1:</b> Interface WiFi module with a Controller	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>Integrate WIFI module with the controller</li> <li>Configure WIFI settings</li> <li>Establish WIFI communication between two different modules</li> <li>Transmit and receive Application data.</li> <li>Rectify the issues in connectivity of the device.</li> </ul>	<ul style="list-style-type: none"> <li>Explain WiFi serial transceiver module</li> <li>Basic knowledge of TCP/IP protocol stack</li> <li>Knowledge of MAC address</li> <li>Knowledge of authentication protocols (WEP, TKIP, AES, WAPI)</li> <li>Knowledge of Wifi Speed and range</li> <li>Connect and configure different wifi modules</li> <li>Transmit and receive data using wifi transceiver</li> <li>Understanding of the transmission problems</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>Practice to configure NodeMCU with temperature sensor and</li> </ul>	<b>Total:</b> 42 hrs  <b>Theory:</b> 8 hrs  <b>Practical:</b> 30 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Internet</li> <li>Computer</li> <li>Multimedia projector</li> <li>Wifi module</li> </ul>	Class room, Lab.

		android app and display its values on app (BLYNK etc.)			
<b>LU2:</b>  Interface Bluetooth module with a controller	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Integrate Bluetooth module with the controller</li> <li>• Configure Bluetooth settings</li> <li>• Establish Bluetooth communication between two different modules</li> <li>• Transmit and receive Application data.</li> <li>• Rectify the issues in connectivity of the device .</li> </ul>	<ul style="list-style-type: none"> <li>• Explain Bluetooth Communication</li> <li>• Explain Bluetooth Versions</li> <li>• Knowledge of BT frequency and modulation methods</li> <li>• Knowledge of BT communication protocol</li> <li>• Knowledge of authentication protocols</li> <li>• Knowledge of BT Speed and range</li> <li>• Connect and configure different BT modules</li> <li>• Transmit and receive data using BT transceiver</li> <li>• Understanding of the transmission problems</li> <li>• Explain BLE Communication</li> <li>• Differentiate BT and BLE technologies</li> <li>• Explain BLE Versions</li> <li>• Knowledge of BLE frequency and modulation methods</li> <li>• Knowledge of BLE communication protocol</li> <li>• Knowledge of authentication protocols</li> <li>• Knowledge of BLE Speed and range</li> <li>• Connect and configure different BLE modules</li> </ul>	<b>Total:</b> 46 hrs  <b>Theory:</b> 9 hrs  <b>Practical:</b> 33 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Internet</li> <li>• Computer system</li> <li>• Bluetooth module</li> <li>• BLE module</li> <li>• Controller</li> <li>• Trainer</li> </ul>	Class room,  Lab.

		<ul style="list-style-type: none"> <li>• Transmit and receive data using BLE transceiver</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to interface BT module with microcontroller and mobile application to control LEDs using mobile app.</li> </ul>			
<b>LU3:</b> Interface ZigBee with a controller	<p><b>Trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Select module through identification number</li> <li>• Download the datasheet</li> <li>• Select coordinator, router and endnode</li> <li>• Configure Zigbee node as End Node</li> <li>• Configure Zigbee Node as Coordinator</li> <li>• Create Zigbee network</li> <li>• Receive the data from the Zigbee Network</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of ZigBee application</li> <li>• Knowledge of ZigBee modules and controller</li> <li>• Knowledge of downloading and reading datasheet</li> <li>• Knowledge of coordinator, router and endnode</li> <li>• Knowledge of configuring Zigbee end nodes as per requirements</li> <li>• Read and record data received from ZigBee modules</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to interface Zigbee module with Raspberry Pi and validate its working using mobile app</li> </ul>	<p><b>Total</b> 46 hrs</p> <p><b>Theory:</b> 5 hrs</p> <p><b>Practical:</b> 33 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• Internet</li> <li>• Computer</li> <li>• Multimedia projector</li> <li>• Instructional manual</li> <li>• ZigBee modules</li> </ul>	Class room, Lab.

## Module 5 : Program Basic Building Blocks using C/C++/

**Objective of the module:** The aim of this module to get knowledge, skills and understanding to perform basic and necessary concepts of programming.

	Duration:	283 Hours	Theory:	52 Hours	Practical:	246 Hours	
Learning Unit	Learning Outcomes		Learning Elements		Duration	Materials Required	Learning Place
LU1: Develop Basic program with Arithmetic Computations	<b>The trainee will be able to:</b> <ul style="list-style-type: none"><li>Install the IDE for coding</li><li>Create basic program structure</li><li>Declare variables according to the requirements</li><li>Implement arithmetic expression in program</li><li>Debug the code in case of error numeric values</li><li>Run the code to display the correct answer</li></ul>		<ul style="list-style-type: none"><li>Describe Program and Programming language</li><li>Knowledge and understanding of IDE</li><li>Compilation steps of a C program.</li><li>Purpose and use of Linker.</li><li>Knowledge of Debugger.</li><li>Installation of Compiler and IDE</li><li>Describe Program structure</li><li>Understanding of data types and variable</li><li>Implement arithmetic expression in programming language C/C++.</li><li>Understanding of precedence of operators</li><li>Understanding of compilation and execution of the program</li><li>Process of debugging</li></ul> <b>Practical Activity:</b> <ul style="list-style-type: none"><li>Practice to calculate area of rectangle in C</li></ul>		<b>Total:</b> 27 hrs <b>Theory:</b> 09 hrs <b>Practical:</b> 21 hrs	<b>Consumable</b> <ul style="list-style-type: none"><li>Notebooks</li><li>Pencils</li><li>Erasers</li><li>Sharpeners</li></ul> <b>Non Consumable</b> <ul style="list-style-type: none"><li>Internet</li><li>Computer system</li><li>C/C++ IDE</li><li>IDE</li><li>Multimedia</li><li>White board</li></ul>	Class room , Computer Lab

		<ul style="list-style-type: none"> <li>Practice to calculate gross salary of an employee from basic salary in C</li> </ul>			
<b>LU2:</b> Develop Basic program with Decision control	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>Create basic program structure</li> <li>Use decision statement as per the requirement of problem</li> <li>Debug the code in case of error</li> <li>Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>Describe Conditional Statements and its types</li> <li>Understanding of nested decision statements.</li> <li>Implementing Decision Control program in C/C++</li> <li></li> <li>Process of debugging</li> </ul> <p><b>Practical Activit:</b></p> <ul style="list-style-type: none"> <li>Practice to calculate grading system based on final marks of a class in C</li> </ul>	<b>Total</b> 21 hrs  <b>Theory:</b> 06 hrs  <b>Practical:</b> 18 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Computer system</li> </ul>	Class room Computer Lab
<b>LU3:</b> Develop Basic programs using loop	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>Create basic program structure</li> <li>Initialize loop control variable</li> <li>Set loop condition</li> <li>Set loop invariant</li> <li>Write the loop as per the requirement of the problem</li> <li>Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>Describe types of Loops and its advantages in Programming</li> <li>Knowledge of handling control variables for a loops</li> <li>Knowledge of breaking a loop</li> <li>Process of implementing loops in a program in C/C++</li> <li>Knowledge of nested loop</li> <li>Process of debugging</li> </ul> <p><b>Practical Activity:</b></p>	<b>Total</b> 22 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 18 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Computer system</li> </ul>	Class room Class room , Computer Lab

		<ul style="list-style-type: none"> <li>Practice to print table from 2 to 10 using nested FOR loop in C</li> <li>Practice to print table from 2 to 10 using nested WHILE loop in C</li> <li>Practice to print ATM option menu using DOWHILE loop in C</li> </ul>			
<b>LU4: Develop programs with arrays</b>	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>Create basic program structure</li> <li>Declare and initialize array</li> <li>Define loop to access array</li> <li>Access elements of array to perform actions as per requirement of the problem</li> <li>Debug the code in case of error</li> <li>Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>Describe Concepts of array</li> <li>Describe Data types of arrays and its declaration</li> <li>Explain Indexing and access of array</li> <li>Knowledge of techniques to sort an array</li> <li>Understanding of implementation of array using C</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to fill 10 elements in array using loop in C</li> </ul>	<b>Total</b> 23 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 18 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Computer system</li> </ul>	Class room  Class room , Computer Lab

		<ul style="list-style-type: none"> <li>Practice to take two character arrays in first insert string "Pakistan" and in 2<sup>nd</sup> insert "Zindabad" and take 3<sup>rd</sup> array and copy previous array elements in it and print 3<sup>rd</sup> array elements in C</li> </ul>			
<b>LU5: Develop programs using pointer</b>	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>Create basic program structure</li> <li>Declare and initialize pointer</li> <li>Assign an address value to pointer</li> <li>Access different memory indices through this value</li> <li>Access elements of an array using pointers</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge of address bus and data bus.</li> <li>Describe Pointers and its Data Types</li> <li>Accessing values using address</li> <li>Implementation process of Pointers and access array elements using pointer in C</li> <li>Knowledge of process to debug.</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to take one variable of integer type and second pointer type pointing to variable one and</li> </ul>	<b>Total</b> 25 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 21 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Computer system</li> </ul>	Class room  Class room , Computer Lab



		<p>print first variable value using pointer in C</p> <ul style="list-style-type: none"> <li>Practice to create an array with 5 elements and access its elements using pointer in C</li> </ul>			
<b>LU6: Develop program with functions</b>	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>Create basic program structure</li> <li>Initialize the function header, with parameters and return type</li> <li>Declare the function, to perform the assigned task.</li> <li>Call the user created function as per requirement of problem</li> <li>Call multiple functions with different parameters and display results.</li> <li>Debug the code in case of error</li> <li>Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>Describe Functions and its types</li> <li>Explain Parameters</li> <li>Declaration of function</li> <li>Function prototype, function definition and function call.</li> <li>Call by reference and call by value.</li> <li>Knowledge of recursion</li> <li>Concept of return type of function</li> <li>Understanding of implementation of function of different return types</li> </ul>	<p><b>Total</b></p> <p>26 hrs</p> <p><b>Theory:</b></p> <p>05 hrs</p> <p><b>Practical:</b></p> <p>21 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>Computer system</li> </ul>	<p>Class room</p> <p>Class room ,</p> <p>Computer Lab</p>

		<p>and different parameter, call them and display results</p> <ul style="list-style-type: none"> <li>• Concept of function overloading</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to create a function for calculation of average of three integers in C</li> <li>• Practice to print factorial</li> <li>• Practice to make function to calculate sum using call by reference and call by value</li> </ul>			
<b>LU7: Develop a program using built-in libraries</b>	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Create basic program structure</li> <li>• Include the header file as required by the problem</li> <li>• Call the functions instructed by task from the built-in library.</li> <li>• Perform the task as per requirement of problem</li> <li>• Debug the code in case of error</li> <li>• Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>• Describe Libraries and its advantages</li> <li>• Explain the header file</li> <li>• Method to implement a program that is using built in library and using its function using C/C++</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to add math.h header file and calculate sin, tan and cos</li> <li>• Practice to add string.h header file. take two strings and use function of strcmp, strcpy and strlen.</li> </ul>	<p><b>Total</b> 21 hrs</p> <p><b>Theory:</b> 03 hrs</p> <p><b>Practical:</b> 18 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• Computer system</li> </ul>	<p>Class room</p> <p>Class room , Computer Lab</p>

<b>LU8: Develop programs using basic classes</b>	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Declare member functions and variables of the class</li> <li>• Create the objects of that class</li> <li>• Initialize the object</li> <li>• Access the functions and data of particular objects.</li> <li>• Debug the code in case of error</li> <li>• Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>• Describe Classes and its benefits</li> <li>• Explain member method and attributes or member variables</li> <li>• Explain how to declare a class and its member methods and member variables</li> <li>• Usage of class using C++</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to make a class named as car</li> <li>• make 3 object of class car and set its parameters using functions</li> </ul>	<p><b>Total</b></p> <p>24 hrs</p> <p><b>Theory:</b></p> <p>03 hrs</p> <p><b>Practical:</b></p> <p>21 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• Computer system</li> </ul>	<p>Class room</p> <p>Class room ,</p> <p>Computer Lab</p>
<b>LU9: Develop programs using encapsulation</b>	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Initialize the function header, with parameters and return type</li> <li>• Declare member functions and variables of the class</li> <li>• Apply encapsulation (private, public) on the classes</li> <li>• Create the objects of that class</li> <li>• Initialize the object</li> <li>• Access the functions and data of particular objects.</li> <li>• Debug the code in case of error</li> </ul>	<ul style="list-style-type: none"> <li>• Describe encapsulation concepts (using access specifier public , private, protected)</li> <li>• Understanding of friend function</li> <li>• process of implementation of classes on Concepts of Encapsulation using C++</li> <li>• Knowledge of gatter setter</li> </ul> <p><b>Practical Activity:</b></p>	<p><b>Total</b></p> <p>28 hrs</p> <p><b>Theory:</b></p> <p>04 hrs</p> <p><b>Practical:</b></p> <p>24 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• Computer system</li> </ul>	<p>Class room</p> <p>Class room ,</p> <p>Computer Lab</p>

	<ul style="list-style-type: none"> <li>Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>Practice to create a class using three private data members and its gatter setter and use them in main function</li> </ul>			
<b>LU10: Develop program using classes with inheritance</b>	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>Declare parent and child classes</li> <li>Declare member functions and variables of in required class</li> <li>Create an objects of child class</li> <li>Access parent class functions using child class objects</li> <li>Initialize the object</li> <li>Access the functions and data of declared objects as per the requirement of the problem</li> <li>Debug the code in case of error</li> <li>Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>Describe Inheritance and its types</li> <li>Explain base/ parent class and Child class Concepts</li> <li>Inheritance concept using C++</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to create parent class and child class</li> <li>declare three functions to calculate average and sum with two and three variables each</li> <li>in child class override sum function</li> <li>in main function create a child class object and calculate sum and average of two and three integers</li> </ul>	<p><b>Total</b></p> <p>25 hrs</p> <p><b>Theory:</b></p> <p>04 hrs</p> <p><b>Practical:</b></p> <p>21 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <p><b>Non</b></p> <p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>Computer system</li> </ul>	<p>Class room</p> <p>Class room ,</p> <p>Computer Lab</p>

<b>LU11: Develop program using classes with polymorphism</b>	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Declare parent and child classes</li> <li>• Declare member functions and variables of the classes</li> <li>• Create objects of both classes parent and child</li> <li>• Initialize the object</li> <li>• Access the functions and data of declared objects to show polymorphic behavior</li> <li>• Debug the code in case of error</li> <li>• Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>• Describe Polymorphism and its concepts (overloading and overriding)</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to declare parent class named as animal and create functions named as sound</li> <li>• Create three child classes named as lion, dog and deer and apply the concept of polymorphism</li> </ul>	<p><b>Total</b></p> <p>27 hrs</p> <p><b>Theory:</b></p> <p>03 hrs</p> <p><b>Practical:</b></p> <p>24 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non</b></p> <p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Computer system</li> </ul>	<p>Class room</p> <p>Class room ,</p> <p>Computer Lab</p>
<b>LU12: Develop program using files</b>	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Write the code to open file from program</li> <li>• Declare member functions and variables of the classes</li> <li>• Write data in that file from the program.</li> <li>• Write code to open another file from program</li> <li>• Read data from that file and display it</li> <li>• Debug the code in case of error</li> <li>• Run the code to display the correct answer</li> </ul>	<ul style="list-style-type: none"> <li>• Describe file system and its benefits</li> <li>• Knowledge to write program to create and open file using C</li> <li>• Knowledge to write program to read file and display data using C</li> <li>• Knowledge to write program to write file using C</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to create a file and write some text in that file and display after read</li> </ul>	<p><b>Total</b></p> <p>24 hrs</p> <p><b>Theory:</b></p> <p>03 hrs</p> <p><b>Practical:</b></p> <p>21 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non</b></p> <p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Computer system</li> </ul>	<p>Class room</p> <p>Class room ,</p> <p>Computer Lab</p>

## Module 6 : Program different applications in Arduino, Raspberry Pi and NodeMCU

**Objective of the module:** The aim of this module to get knowledge, skills and understanding to start programming on Arduino. It also provides an introduction to the main syntax required for Arduino programming.

	<b>Duration:</b>	103 hours	<b>Theory:</b>	22 hours	<b>Practical:</b>	81 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place	
<b>LU1:</b> Develop applications on Arduino	<b>The trainee will be able to:</b> <ul style="list-style-type: none"><li>• setup environment for Arduino IDE</li><li>• Perform LED blink with basic digital wire</li><li>• Perform multiple LED handling with loops and arrays</li><li>• Control digital input and output</li><li>• Test LED Fader with Analog Input handling</li><li>• Control Serial communication Perform Interfacing with accelerometer</li><li>• Interrupt handling with button</li></ul>	<ul style="list-style-type: none"><li>• Knowledge of circuit to drive LED.</li><li>• Knowledge of pin configuration and pin functionalities of Arduino.</li><li>• Process to interface Arduino with computer.</li><li>• Interfacing LED circuit with Arduino.</li><li>• Knowledge of writing a program to control LED using array and compile.</li><li>• Process of connecting Push Button with Arduino</li><li>• Understanding of digital and analog GPIOs</li><li>• Explain PWM (Pulse Width Modulator) and PWM PIns</li><li>• Process to connect LED with PWM pin Arduino.</li><li>• Knowledge of writing a program to control LED’s brightness.</li><li>• Process of interfacing accelerometer with Arduino<ul style="list-style-type: none"><li>○ Knowledge of Writing the code to get values from accelerometer and display them on serial monitor.</li></ul></li><li>• Describe Interrupts and its types.</li></ul>	<b>Total:</b> 27 hrs  <b>Theory:</b> 06 hrs  <b>Practical:</b> 21 hrs	<b>Consumable</b> <ul style="list-style-type: none"><li>• Notebooks</li><li>• Pencils</li><li>• Erasers</li><li>• Sharpeners</li></ul> <b>Non Consumable</b> <ul style="list-style-type: none"><li>• Whiteboard</li><li>• Multimedia</li><li>• Computer system</li><li>• Arduino Uno</li><li>• LED</li></ul>	Class room ,  Computer Lab	

		<ul style="list-style-type: none"> <li>• Concept of Interrupt Service Routines.</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to write a program to blink an LED at digital to output pin of Arduino</li> </ul>			
<b>LU2:</b> Develop applications on Raspberry Pi	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• setup environment for Raspberry Pi</li> <li>• Perform LED blink with basic digital wire</li> <li>• Handle multiple LED with loops and arrays</li> <li>• Control Multiple LEDs with loops and arrays</li> <li>• Control digital input and output.</li> <li>• Control LED's glow with Analog Input handling</li> <li>• Interface with accelerometer sensor</li> <li>• Control Interrupts with push button</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of Wiring Pi Library.</li> <li>• Knowledge of process to compile C programs in Raspberry Pi.</li> <li>• Implementing a program that blink LED in Raspberry Pi</li> <li>• Knowledge of process to make and run executable files in Raspberry Pi</li> <li>• Monitoring the application messages in Raspberry Pi command line interface</li> <li>• Process of implementing a program that control multiple LED's</li> <li>• Making GPIOs input and output pins.</li> <li>• Understanding of PWM and its pins In Raspberry Pi</li> <li>• Understanding a program that fade LED</li> <li>• Connecting LED with PWM of Raspberry Pi</li> <li>• Techniques of compiling and executing C applications in C</li> <li>• Basic understanding of data sheets.</li> <li>• Theory of accelerometer.</li> </ul>	<p><b>Total:</b></p> <p>38 hrs</p> <p><b>Theory:</b></p> <p>8 hrs</p> <p><b>Practical:</b></p> <p>30 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpener</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• Whiteboard</li> <li>• Multimedia</li> <li>• Computer system</li> <li>• Raspberry Pi</li> <li>• LED</li> </ul>	

		<ul style="list-style-type: none"> <li>• Basic knowledge of gyroscope.</li> <li>• Basic knowledge of filters for accelerometer and gyroscope.</li> <li>• Interfacing accelerometer with Raspberry Pi.</li> <li>• Describe Interrupts and its types</li> <li>• Concept of Interrupt service routine.</li> <li>• Difference between blocking and non-blocking commands.</li> <li>• Difference between polling and interrupts.</li> <li>• Technique of connecting LED with digital pin and push button on interrupt pin of Raspberry Pi</li> <li>• Understanding of writing a program that Interrupt the LED state using Interrupt service routine</li> <li>• Understanding of writing program to get values from accelerometer.</li> <li>• Monitoring the values of accelerometer on command line.</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to Build an alarmed motion sensor on Raspberry Pi</li> </ul>			
<b>LU3:</b> Develop applications in NodeMCU	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Set up the environment for NodeMCU</li> <li>• Perform LED blink with basic digital wire</li> </ul>	<ul style="list-style-type: none"> <li>• Installing NodeMCU Library</li> <li>• Interfacing LED driver with NodeMCU</li> <li>• Process of compilation and uploading code on NodeMCU</li> <li>• Connecting LED's with NodeMCU.</li> </ul>	<p><b>Total:</b></p> <p>38 hrs</p> <p><b>Theory:</b></p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> </ul>	



	<ul style="list-style-type: none"> <li>• Handle multiple LED handling with loops and arrays</li> <li>• Handle digital input and output</li> <li>• Fade LED's glow with Analog Input handling</li> <li>• Handle Serial communication</li> <li>• Perform Interfacing with accelerometer</li> <li>• Interrupt handling with button</li> </ul>	<ul style="list-style-type: none"> <li>• Process of connecting Push Button with NodeMCU</li> <li>• Write a program to take input from button and turn on LED</li> <li>• Explanation of PWM (Pulse Width Modulator) and PWM Pins</li> <li>• Interfacing NodeMCU with Computer.</li> <li>• Knowledge and description of UART protocol.</li> <li>• Difference between UART and USART.</li> <li>• Process of using of TTL converter.</li> <li>• Concept of writing a program to take input from button and print it on Serial monitor</li> <li>• Concept of filters applied on accelerometer and gyroscope.</li> <li>• Connecting accelerometer with Node MCU.</li> <li>• Knowledge of writing the code to program to get values from accelerometer and display them on serial monitor.</li> <li>• Knowledge of ISR.</li> <li>• Concept of Interrupt's priority.</li> <li>• Difference between interrupt and exception.</li> <li>• Difference between interrupt and polling.</li> </ul> <p><b>Practical Activity:</b></p>	08 hrs <b>Practical:</b> 30 hrs	<ul style="list-style-type: none"> <li>• Sharpeners</li> </ul> <div>Non Consumable</div> <ul style="list-style-type: none"> <li>• Whiteboard</li> <li>• Multimedia</li> <li>• Computer system</li> <li>• NodeMCU</li> <li>• LED</li> </ul>	
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		<ul style="list-style-type: none"><li>• Practice to Control LED lights using NodeMCU</li></ul>			
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## Module 7 : Perform Arduino ,raspberry Pi and Node MCU interfacing with sensors

**Objective of the module:** The aim of this module to get knowledge, skills and understanding to interface Arduino with various sensors and modules. It provides an introduction to the main theories and activities associated with Arduino with various sensors and modules being applied in industry.

	Duration:	116 hours	Theory:	26 hours	Practical:	90 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place	
LU1: Perform Arduino interfacing with sensors	<p>The trainee will be able to:</p> <ul style="list-style-type: none"><li>Program Arduino with Infrared Sensor for outputs</li><li>Program Arduino with Current Sensor for output</li><li>Program Arduino with Voltage Sensor for Outputs</li><li>Program Arduino with Ultrasonic Sensor</li><li>Program Arduino with Bluetooth Module</li><li>Program Arduino with WIFI Module</li><li>Program Arduino with RFID module</li><li>Program Arduino with Relay module</li><li></li></ul>	<ul style="list-style-type: none"><li>Understanding of IR sensor</li><li>Transducing principle of IR receiver.</li><li>Understanding of circuit to interface IR transmitter and receiver with Arduino.</li><li>Implement a program of Obstacle Detection with Infrared Sensor</li><li>Understanding of Current sensor.</li><li>Zero crossing detector circuit.</li><li>Connect Current Sensor with Arduino</li><li>Implement a program to read analogue input from current sensor.</li><li>Understanding of Voltage sensor.</li><li>Connect Voltage Sensor with Arduino</li><li>Implementing a program to read analogue input from Voltage sensor.</li></ul>	<p>Total:</p> <p>36 hrs</p> <p>Theory:</p> <p>09 hrs</p> <p>Practical:</p> <p>27 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"><li>Notebooks</li><li>Pencils</li><li>Erasers</li><li>Sharpeners</li></ul> <p>Non Consumable</p> <ul style="list-style-type: none"><li>Computer system</li><li>Multimedia projector</li><li>Internet</li></ul>	Class room , Computer Lab	

		<ul style="list-style-type: none"> <li>• Understanding of Ultrasonic Sensor.</li> <li>• Basic theory of sound waves.</li> <li>• Interfacing Ultrasonic Sensor with Arduino</li> <li>• Implementing a program that calculates distance using Ultrasonic Sensor.</li> <li>• Understanding of Bluetooth Module.</li> <li>• Basic knowledge of Bluetooth protocol.</li> <li>• Interfacing Bluetooth Module with Arduino</li> <li>• Implementing a program control LED using your Bluetooth module</li> <li>• Understanding of ESP8266 WIFI Module.</li> <li>• Basic knowledge of Wi-Fi protocol.</li> <li>• Process to Connect ESP8266 WIFI Module with Arduino</li> <li>• Process to implement a program control LED using your ESP8266 WIFI module</li> <li>• Understanding of RFID Module</li> <li>• Connecting RFID Module with Arduino</li> <li>• Process to Implement a counter using RFID module</li> <li>• Understanding of Relay Module.</li> <li>• Understanding of Coil, armature.</li> </ul>			
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		<ul style="list-style-type: none"> <li>• Concept of Normally Open and Normally Closed pins.</li> <li>• Process of Connecting Relay Module with Arduino</li> <li>• Process of Implementing a program to toggle LED Bulb using Relay</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to Build Automated Fan Control using Arduino</li> </ul>			
<b>LU2:</b> Perform Raspberry Pi interfacing with sensors	<p><b>The trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Interface Raspberry PI with Infrared Sensor</li> <li>• Interface Raspberry PI with Current Sensor</li> <li>• Interface Raspberry PI with Voltage Sensor</li> <li>• Raspberry PI with Ultrasonic Sensor</li> <li>• Raspberry PI with Bluetooth Module</li> <li>• Raspberry PI with WIFI Module</li> <li>• Raspberry PI with RFID module</li> <li>• Raspberry PI with Relay module</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of IR sensor.</li> <li>• Understanding of IR interfacing circuits.</li> <li>• Connect IR Sensor with Raspberry PI</li> <li>• Implement a program of Obstacle Detection with Infrared Sensor</li> <li>• Understanding of Current sensor.</li> <li>• Zero crossing detector.</li> <li>• Connecting Current Sensor with Raspberry PI</li> <li>• Implement a program to read analog input from current sensor.</li> <li>• Understanding of Voltage sensor</li> <li>• Connecting Voltage Sensor with Raspberry PI</li> <li>• Implementing a program to read analog input from Voltage sensor.</li> <li>• Understanding of Ultrasonic Sensor.</li> </ul>	<p><b>Total:</b> 39 hrs</p> <p><b>Theory:</b> 09 hrs</p> <p><b>Practical:</b> 30 hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Multimedia projector</li> <li>• Internet</li> </ul>	Class room , Computer Lab

		<ul style="list-style-type: none"> <li>• Knowledge of ultrasonic waves.</li> <li>• Connecting Ultrasonic Sensor with Raspberry PI</li> <li>• Implementing a program that calculates distance using Ultrasonic Sensor.</li> <li>• Understanding of Bluetooth Module and Bluetooth protocol.</li> <li>• Implementing a program Control LED using your Bluetooth module</li> <li>• Understanding of ESP8266 WIFI Module and Wi-Fi protocol.</li> <li>• Implementing a program control LED using your Raspberry PI WIFI module.</li> <li>• Knowledge of FTP.</li> <li>• Understanding of RFID Module</li> <li>• Connecting RFID Module with Raspberry PI</li> <li>• Implementing a program of counting using RFID module</li> <li>• Understanding of Relay Module.</li> <li>• Knowledge of coil, armature, NC and NO pins.</li> <li>• Connecting Relay Module with Raspberry PI</li> <li>• Implementing a program to toggle LED Bulb using Relay</li> </ul> <p><b>Practical Activity:</b></p>			
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		<ul style="list-style-type: none"> <li>Practice to Build Automated Fan Control using Raspberry Pi</li> </ul>			
<b>LU3:</b> Perform NodeMCU interfacing with sensors	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>Interface NodeMCU with Infrared Sensor</li> <li>Interface NodeMCU with Current Sensor</li> <li>Interface NodeMCU with Voltage Sensor</li> <li>NodeMCU with Ultrasonic Sensor</li> <li>NodeMCU with Bluetooth Module</li> <li>NodeMCU with WIFI Module</li> <li>NodeMCU with RFID module</li> <li>NodeMCU with Relay module</li> </ul>	<ul style="list-style-type: none"> <li>Understanding of IR sensor</li> <li>Connect IR Sensor with NodeMCU.</li> <li>Implementing a program of Obstacle Detection with Infrared Sensor</li> <li>Understanding of Current sensor.</li> <li>Zero Crossing detector.</li> <li>Connect Current Sensor with NodeMCU</li> <li>Implement a program to read analog input from current sensor.</li> <li>Processing of calibration</li> <li>Understanding of Voltage sensor</li> <li>Connect Voltage Sensor with NodeMCU</li> <li>Understanding of Ultrasonic Sensor.</li> <li>Knowledge of ultrasonic waves.</li> <li>Connecting Ultrasonic Sensor with NodeMCU</li> <li>Implementing a program that calculate distance using Ultrasonic Sensor.</li> <li>Understanding of Bluetooth Module</li> <li>Connecting Bluetooth Module with NodeMCU</li> <li>Implementing a program to control LED using your Bluetooth module</li> </ul>	<b>Total:</b> 41 hrs  <b>Theory:</b> 08 hrs  <b>Practical:</b> 33 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>Computer system</li> <li>Multimedia projector</li> <li>Internet</li> </ul>	Class room ,  Computer Lab

		<ul style="list-style-type: none"> <li>• Understanding of ESP8266 WIFI Module.</li> <li>• Knowledge of Wi-Fi protocol.</li> <li>• Implementing a program control LED using your ESP8266 WIFI module</li> <li>• Understanding of RFID Module</li> <li>• Connecting RFID Module with NodeMCU</li> <li>• Implementing a program of counting using RFID module</li> <li>• Understanding of Relay Module</li> <li>• Connecting Relay Module with NodeMCU</li> <li>• Implementing a program to toggle LED Bulb using Relay</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Practice to Build Automated Fan Control using NodeMCU</li> </ul>			
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## Module 8 : Perform Socket Programming

**Objective of the module:** The aim of this module to get knowledge, skills and understanding to demonstrate the understanding of basic socket programming using TCP and UDP. It provides a hands-on grasp on client server communication using sockets.

	Duration:	91 hours	Theory:	16 hours	Practical:	75 hours	
Learning Unit	Learning Outcomes	Learning Elements			Duration	Materials Required	Learning Place
LU1: Develop the code for communication between client and server	<p>The trainee will be able to:</p> <ul style="list-style-type: none"><li>Write code to open a socket.</li><li>Write code to open an input stream and output stream to the socket.</li><li>Read from and write to the stream according to the server's protocol.</li><li>Listen for the connection on server side</li><li>Close the streams.</li><li>Close the socket.</li><li>perform communication between client and server using socket programming</li><li>Perform socket troubleshooting</li></ul>	<ul style="list-style-type: none"><li>Basic knowledge of Networking</li><li>Understanding of Client server model</li><li>Knowledge of Socket, input and output stream</li><li>Knowledge of writing code for socket programming</li><li>Understanding of blocking and non-blocking sockets</li><li>Knowledge of transport Layer protocols</li><li>Knowledge of assigning IP's and local host</li><li>TCP and UDP Protocols</li><li>Understanding of server side troubleshooting</li><li>Understanding router troubleshoot</li><li>Understanding of operating system ports (port 80, 21, etc.)</li></ul> <p>Practical Activity:</p>			<p>Total:</p> <p>34 hrs</p> <p>Theory:</p> <p>9 hrs</p> <p>Practical:</p> <p>33 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"><li>Notebooks</li><li>Pencils</li><li>Erasers</li><li>Sharpeners</li></ul> <p>Non Consumable</p> <ul style="list-style-type: none"><li>Computer system</li><li>Multimedia projector</li><li>Internet</li><li>Raspberry Pi</li></ul>	<p>Class room ,</p> <p>Computer Lab</p>

		<ul style="list-style-type: none"> <li>Practice to write a code for server side and client side and communicate between them using socket programming.</li> </ul>			
<b>LU2:</b> Develop the code for multi-client server	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>Write code to open a socket.</li> <li>Write code to open an input stream and output stream to the socket. Listen for the connection for multiple clients</li> <li>Start an independent thread for the connection</li> <li>Close the streams.</li> <li>Close the socket in case of exception</li> <li>Perform socket troubleshooting</li> </ul>	<ul style="list-style-type: none"> <li>Basic understanding of DNS servers</li> <li>Basic understanding of ports and network addressing</li> <li>Knowledge of threads and P-thread library</li> <li>Concept of multi-client server</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>Practice to write a code for server side to perform basic arithmetic operation, connect two clients using socket programming to use these arithmetic operations defined in server side code</li> </ul>	<b>Total</b> 56 hrs  <b>Theory:</b> 10 hrs  <b>Practical:</b> 42 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>Notebooks</li> <li>Pencils</li> <li>Erasers</li> <li>Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>White board</li> <li>Multimedia</li> <li>Internet</li> <li>Computer system</li> </ul>	Class room , Computer Lab

## Module 9      Develop mobile apps using MIT APP inventor

**Objective of the module:** The aim of this module to get knowledge, skills and understanding to demonstrate the understanding of Android App development using MIT App Inventor. It provides a detailed grasp on basic programming skills required for App Inventor usage.

	<b>Duration:</b>	130 hours	<b>Theory:</b>	22 hours	<b>Practical:</b>	108 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place	
<b>LU1:</b> Transfer app to mobile device via USB and WIFI	<b>The trainee will be able to:</b> <ul style="list-style-type: none"><li>• Open the IDE for coding</li><li>• Code a simple hello world program</li><li>• Compile a code</li><li>• Debug the code (in case of error)</li><li>• Run a code on emulator</li><li>• Create a <i>hello world</i> app using app inventor</li><li>• Connect to mobile while WiFi and transfer app to mobile and run it.</li><li>• Connect to mobile via USB and transfer app to mobile and run it</li></ul>	<ul style="list-style-type: none"><li>• Understanding of flow charts</li><li>• Knowledge of MIT App inventor interface.</li><li>• Understanding of transferring application to mobile phone using USB cable and WIFI.</li></ul> <b>Practical Activity:</b> <ul style="list-style-type: none"><li>• Practice to develop hello world app by following below mentioned steps:<ul style="list-style-type: none"><li>➤ write code for program</li><li>➤ compile code</li><li>➤ develop app</li><li>➤ transfer app to mobile</li></ul></li></ul>	<b>Total</b> 27 hrs <b>Theory:</b> 06 hrs <b>Practical:</b> 21 hrs	<b>Consumable</b> <ul style="list-style-type: none"><li>• Notebooks</li><li>• Pencils</li><li>• Erasers</li><li>• Sharpeners</li></ul> <b>Non Consumable</b> <ul style="list-style-type: none"><li>• Computer system</li><li>• Internet</li></ul>	Class room ,  Computer Lab	

<b>LU2:</b> Develop Basic app with user interface	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Make basic app structure with single activity/screen</li> <li>• Use some basic user interface controls as required by the problem</li> <li>• Transfer the code to mobile and execute</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of activity.</li> <li>• Common UI elements.</li> <li>• Understanding of user interface.</li> <li>• Understanding of On-click actions.</li> <li>• Deploy App in phone.</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Practice to create app using basic user interface</li> </ul>	<b>Total:</b> 22 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 18 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Internet</li> </ul>	Class room , Computer Lab
<b>LU3:</b> Develop app with multi-screen	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Make basic app structure with two activities/screens</li> <li>• Use some basic user interface controls as required by the problem</li> <li>• Switch from one screen to next</li> <li>• Transfer the code to mobile and execute</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of activities.</li> <li>• Understanding of switching Activities.</li> <li>• Deploy App in phone.</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Practice to develop an app with multi-screens <ul style="list-style-type: none"> <li>➤ take input on 1<sup>st</sup> screen</li> <li>➤ display that input on the 2<sup>nd</sup> screen</li> </ul> </li> </ul>	<b>Total:</b> 14 hrs  <b>Theory:</b> 02 hrs  <b>Practical:</b> 12 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Internet</li> </ul>	Class room , Computer Lab

<b>LU4:</b> Develop app to interact with phone Call	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Make user interface with a phone dialer</li> <li>• Write the code to Initialize call on selected number</li> <li>• Transfer the code to phone and check if the call gets connected</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of process to connect app with phone call</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Practice to make user interface in mit app inventor and add call functionality.</li> </ul>	<b>Total:</b> 17 hrs  <b>Theory:</b> 02 hrs  <b>Practical:</b> 15 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Internet</li> </ul>	Class room, Computer Lab
<b>LU5:</b> Develop app to interact with location sensor	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Make user interface to show location data</li> <li>• Write code to get the location data from sensor whenever the location changes and display</li> <li>• Transfer the code to phone and check if the call gets connected</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of maps</li> <li>• Understanding of how to integrate maps in your MIT App</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Practice to make app to show the location data from different locations.</li> </ul>	<b>Total:</b> 14 hrs  <b>Theory:</b> 03 hrs  <b>Practical:</b> 15 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Internet</li> </ul>	Class room , Computer Lab

<b>LU6:</b> Develop app to transmit data to local Database	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Make basic app to take some data from user.</li> <li>• Store that data to the local DB</li> <li>• Make another app to read data from local DB</li> <li>• Extract data for the same DB used in first app and display it</li> <li>• Transmit both app to mobile</li> <li>• Run both apps in set order</li> <li>• Ensure coordination among both apps</li> </ul>	<ul style="list-style-type: none"> <li>• Basic understanding database</li> <li>• Understanding of process to connect your app with databases</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Practice to make an app to take user personal information from user and store in local DB and make an app to show the stored data from database.</li> </ul>	<b>Total:</b> 18 hrs  <b>Theory:</b> 03 hrs  <b>Practical:</b> 15 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Internet</li> </ul>	Class room , Computer Lab
<b>LU7:</b> Install App Inventor support for Arduino	<b>The trainee will be able to:</b> <ul style="list-style-type: none"> <li>• Set up Arduino IDE</li> <li>• Install App Inventor support for Arduino</li> <li>• Interface Arduino with computer</li> <li>• Transfer AIM-for-Things-Arduino101.ino to board</li> <li>• App inventor should be able to access Arduino</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of 101 or IOT libraries of Arduino</li> <li>• Understanding of integration of IOT with app inventor and Arduino.</li> </ul> <b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Practice to make an mobile app to connect with Arduino and get sensor reading</li> </ul>	<b>Total:</b> 14 hrs  <b>Theory:</b> 02 hrs  <b>Practical:</b> 12 hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <b>Non Consumable</b> <ul style="list-style-type: none"> <li>• Computer system</li> <li>• Internet</li> </ul>	Class room , Computer Lab

## Module 10 Develop a Smart Home Based Project

**Objective of the module:** This competency standard covers the skills and knowledge required to develop good communication skills

<b>Duration:</b>	73 hours	<b>Theory:</b>	7 hours	<b>Practical:</b>	66 hours
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Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
<b>LU1.</b> Control AC Lights and Fans through Android Application	<b>Trainee will be able to:</b> <ul style="list-style-type: none"> <li>Interface Relay Driving Circuit with NodeMCU.</li> <li>Connect a bulb/fan with the relay.</li> <li>Write a C/C++ application on NodeMCU to trigger relay.</li> <li>Apply code to connect NodeMCU to available Wi-Fi router / access point.</li> <li>Apply code to connect to any public MQTT broker.</li> <li>Create this topic on the broker.</li> <li>Add in the code (NodeMCU program) to subscribe to this topic.</li> <li>Build a Simple Android application with a button / switch and MQTT client.</li> <li>Add functionality in the Android app that whenever switch is on, send a MQTT message on the same topic.</li> <li>Add functionality in the NodeMCU code that whenever</li> </ul>	<ul style="list-style-type: none"> <li>Understanding of relays.</li> <li>Knowledge of NodeMCU</li> <li>Knowledge of writing C programs for NodeMCU.</li> <li>Understanding of MQTT protocol.</li> <li>Knowledge of developing Android applications.</li> <li>Using Switch in Android application.</li> </ul>	<b>Total:</b> 37 hrs  <b>Theory:</b> 04 hrs  <b>Practical:</b> 33 hrs	<ul style="list-style-type: none"> <li>Computer System</li> <li>NodeMCU</li> <li>MQTT</li> <li>Button</li> <li>Switch</li> <li>Fan</li> <li>Light</li> </ul>	Class Room & Workshop

	<p>this message is received, turn on the relay.</p> <ul style="list-style-type: none"> <li>• Execute the code on NodeMCU and control relay from android app.</li> </ul>				
<p><b>LU2.</b> Receive Indoor sensor's value on android app</p>	<p><b>Trainee will be able to:</b></p> <ul style="list-style-type: none"> <li>• Interface temperature / humidity sensor with NodeMCU .</li> <li>• Write a code to read its value in C/C++.</li> <li>• Add in this code to connect to a Wi-Fi router.</li> <li>• Add MQTT client functionality in code.</li> <li>• Create a topic on any public MQTT broker</li> <li>• Add in NodeMCU code to connect and send sensor's value to this broker on the created topic.</li> <li>• Build a Simple Android application with a Textview and MQTT client.</li> <li>• Subscribe the MQTT client in android app to the same topic and display the received message on textview.</li> <li>• Execute the code on NodeMCU and check received value on android app.</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of sensors.</li> <li>• Knowledge of Interfacing sensors with NodeMCU</li> <li>• Knowledge of writing C/C++ programs for NodeMCU.</li> <li>• Using MQTT in C applications.</li> <li>• Knowledge of developing MQTT based Android applications.</li> <li>• Using TextView in Android application.</li> </ul>	<p><b>Total:</b> 36 hrs</p> <p><b>Theory:</b> 03 hrs</p> <p><b>Practical:</b> 33 hrs</p>	<ul style="list-style-type: none"> <li>• Computer System</li> <li>• NodeMCU</li> <li>• MQTT</li> <li>• Button</li> <li>• Switch</li> <li>• Fan</li> <li>• Light</li> </ul>	<p>Class Room &amp; Workshop</p>



## Module 11 Work in a Team Environment

**Objective of the module:** The aim of this module to get knowledge, skills and understanding to work in a team environment.

**Duration:** 30 hours      **Theory:** 12 hours      **Practical:** 18 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
<b>LU1:</b> Obtain and convey Workplace information	<b>The trainee will be able to:</b> <ol style="list-style-type: none"> <li>1. Assess the specific and relevant information from the appropriate sources</li> <li>2. Convey the information using the appropriate medium and ideas</li> <li>3. Use appropriate non- verbal communication</li> <li>4. Identify appropriate lines of communication with supervisors and colleagues</li> </ol>	<ul style="list-style-type: none"> <li>• Describe the importance of effective communication</li> <li>• State different Sources of information</li> <li>• State different mode of communication</li> <li>• Explain types of non-verbal communication</li> <li>• Explain mode of communication while operating machines</li> <li>• Explain the method of recording the information/instructions.</li> <li>•</li> </ul>	<b>Total:</b> 8hrs  <b>Theory:</b> 5hrs  <b>Practical:</b> 3hrs	<b>Consumable</b> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> <li>• Pen</li> <li>• White board marker</li> </ul> <b>Non-Consumable</b> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Internet</li> </ul>	<ul style="list-style-type: none"> <li>• Class Room/Lab</li> </ul>

	<p>5. Use the defined workplace procedures for storage of information</p> <p>6. Inform co-workers and superiors about any deviation</p>	<p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Role Play each trainee introduce himself.</li> <li>• Convey the job description and company general rules and regulations to fellow workers</li> </ul>		<ul style="list-style-type: none"> <li>• Computer system</li> </ul>	
<p><b>LU2:</b> Participate in workplace meetings and discussions</p>	<p><b>The trainee will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Express your own opinions</li> <li>2. Listen other's point of view without interruption</li> <li>3. Prepare simple questions about workplace procedures</li> </ol>	<ul style="list-style-type: none"> <li>• Describe the protocol of meeting</li> <li>• Describe the role and objective of team.</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Participate in mock meeting for preparation to perform job.</li> </ul>	<p><b>Total:</b>7hrs</p> <p><b>Theory:</b>2hrs</p> <p><b>Practical:</b> 5hrs</p>	<p><b>Consumable</b></p> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> <li>• White board marker</li> </ul> <p><b>Non Consumable</b></p> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Internet</li> <li>• Computer system</li> </ul>	<ul style="list-style-type: none"> <li>• Class Room/Lab</li> </ul>

<b>LU3:</b> Identify own role and responsibility within team	<b>The trainee will be able to:</b> <ol style="list-style-type: none"> <li>1. Identify the individual role and responsibilities within the team environment.</li> <li>2. Recognize the roles and responsibility of other team members.</li> <li>3. Report relationships within team and external to team</li> <li>4. Share report with co-workers.</li> </ol>	<ul style="list-style-type: none"> <li>• Describe the importance of creating cooperative work environment</li> <li>• Describe the role and objective of team.</li> <li>• Explain risk of failure team work on the project.</li> <li>• Describe the importance of resolving the co-worker's problems</li> <li>• State plan work and organize required resources in coordination with team</li> </ul> <p><b>Practical Activity:</b></p> <ul style="list-style-type: none"> <li>• Role Play, get instruction regarding job order from supervisor and convey it to coworkers according</li> </ul>	<b>Total:</b> 7hrs  <b>Theory:</b> 2hrs  <b>Practical:</b> 5hrs	<div>Consumable</div> <ul style="list-style-type: none"> <li>• Notebooks</li> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> <li>• White board marker</li> </ul> <div>Non Consumable</div> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Internet</li> <li>• Computer system</li> <li>• White board marker</li> <li>• </li> </ul>	<ul style="list-style-type: none"> <li>• Class Room/Lab</li> </ul>
<b>LU4:</b> Support the co-workers	<b>The trainee will be able to:</b>	<ul style="list-style-type: none"> <li>• Describe the importance of creating cooperative work environment</li> </ul>	<b>Total:</b> 7hrs	<div>Consumable</div> <ul style="list-style-type: none"> <li>• Notebooks</li> </ul>	<ul style="list-style-type: none"> <li>• Class Room/Lab</li> </ul>

	<ol style="list-style-type: none"> <li>1. Hand over the required materials and tools timely to interfacing team</li> <li>2. Work together with co-workers in an effective manner.</li> <li>3. Address the problems of co-worker effectively</li> <li>4. Report to immediate boss</li> </ol>	<ul style="list-style-type: none"> <li>• Describe the importance of resolving the co-worker's problems</li> </ul>	<b>Theory:</b> 2hrs  <b>Practical:</b> 5hrs	<ul style="list-style-type: none"> <li>• Pencils</li> <li>• Erasers</li> <li>• Sharpeners</li> </ul> <div>Non</div> <div>Consumable</div> <ul style="list-style-type: none"> <li>• White board</li> <li>• Multimedia</li> <li>• Internet</li> </ul> Computer system	
		<b>Practical Activity:</b> <ul style="list-style-type: none"> <li>• Role Play, Support and guide stressed coworker in his work related activity</li> </ul>			

## General assessment guidance for “*Internet of Things*”

Good practice in Pakistan makes use of sessional and final assessments, the basis of which is described below. Good practice by vocational training providers in Pakistan is to use a combination of these sessional and final assessments, combined to produce the final qualification result.

**Sessional assessment** is going on all the time. Its purpose is to provide feedback on what students are learning:

- To the student: to identify achievement and areas for further work
- To the teacher: to evaluate the effectiveness of teaching to date, and to focus future plans.

Assessors need to devise sessional assessments for both theoretical and practical work. Guidance is provided in the assessment strategy

**Final assessment** is the assessment, usually on completion of a course or module, which says whether or not the student has "passed". It is – or should be – undertaken with reference to all the objectives or outcomes of the course, and is usually fairly formal. Considerations of security – ensuring that the student who gets the credit is the person who did the work – assume considerable importance in final assessment.

### **Methods of assessment**

For lessons with a high quantity of theory, written or oral tests related to learning outcomes and/ or learning content can be conducted. For workplace lessons, assessment can focus on the quality of planning the related process, the quality of executing the process, the quality of the product and/or evaluation of the process.

Methods include direct assessment, which is the most desirable form of assessment. For this method, evidence is obtained by direct observation of the student's performance.

Examples for direct assessment of Internet of Thing:

- Work performances, for example Create a simple app using app inventor that connects with Arduino board over Bluetooth and receive the sensor data to be displayed.
- Work Performances, for example Develop a regulated power supply that will power up your digital circuit
- Demonstrations, for example Design a Fan dimmer circuit.

- Direct questioning, where the assessor would ask the student why he is preparing for a particular application.
- Paper-based tests, such as short answer questions on health and safety, communication skills etc.

Indirect assessment is the method used where the performance could not be watched and evidence is gained indirectly.

Examples for indirect assessment of Internet of Thing include:

- Work products, IOT Project portfolio
- Workplace documents, such as a report on health and safety etc.

Indirect assessment should only be a second choice. (In some cases, it may not even be guaranteed that the work products were produced by the person being assessed.)

### **Principles of assessment**

All assessments should be valid, reliable, fair and flexible:

Fairness means that there should be no advantages or disadvantages for any assessed person. For example, it should not happen that one student gets prior information about the type of work performance that will be assessed, while another candidate does not get any prior information.

Validity means that a valid assessment assesses what it claims to assess, for example, let's imagine if you have **thousands of sensors**, collecting various data all around us. A solution that scale would be to have these microcontrollers sending data securely to the Cloud.

Reliability means that the assessment is consistent and reproducible. The results for the particular application should be the same.

Flexibility means that the assessor has to be flexible concerning the assessment approach. For example, if there is a power failure during the assessment, the assessor should modify the arrangements to accommodate the students' needs.

## **Assessment strategy for “*Internet of Things*”**

This curriculum consists of 11 modules

1. Interface sensors and actuators
2. Apply microcontroller interfacing protocols
3. Configure ADC & PWM of a controller

4. Identify and interface short range wireless technologies (Wifi, Bluetooth, RFID, Zigbee, BLE) with the microcontrollers
5. Program basic building blocks using C/
6. Program different applications in Arduino, Raspberry Pi, NodeMCU
7. Perform Arduino, Raspberry Pi, NodeMCU Interfacing with sensors
8. Perform socket programming
9. Develop mobile apps using MIT APP Inventor
10. Develop a smart home based project
11. Work in a team

## **Sessional assessment**

The Sessional assessment for all modules shall be in two parts: theoretical assessment and practical assessment. The Sessional marks shall contribute to the final qualification.

Theoretical assessment for all learning modules must consist of a written paper lasting at least half-hour per module. This can be short answer questions.

For practical assessment, all procedures and methods for the modules must be assessed on a sessional basis. Guidance is provided below under Planning for assessment.

## **Final assessment**

Final assessment shall be in two parts: theoretical assessment and practical assessment. The final assessment marks shall contribute to the final qualification.

The final theoretical assessment shall consist of short-answer questions. This part shall cover the technical, functional and generic modules:

### **For Level -4**

- Module 1 Interface sensors and actuators
- Module 2 Apply microcontroller interfacing protocols
- Module 3 Configure ADC & PWM of a controller
- Module 4 Identify and interface short range wireless technologies (Wifi, Bluetooth, RFID, Zigbee, BLE) with the microcontrollers
- Module 5 Program basic building blocks using C/
- Module 6 Program different applications in Arduino, Raspberry Pi, NodeMCU
- Module 7 Perform Arduino, Raspberry Pi, NodeMCU Interfacing with sensors
- Module 8 Perform socket programming
- Module 9 Develop mobile apps using MIT APP Inventor
- Module 10 Develop a smart home based project
- Module 11 Work in team

For the final practical assessment each student shall be assessed over a period of one day, with Four hour sessions for each student. During this period, each student must be assessed on his/her ability to the following parameters of security services;



- Area of responsibility
- Tasks
- Guards
- Resources and duties

## Complete list of tools and equipment

Sr#	Description	Quantity
1.	Android Studio	Free
2.	Arduino Uno	25
3.	USB mini wire	25
4.	Audio signal generator.	20
5.	AutoCAD software	5
6.	AVO meter/ Digital multimeter	25
7.	Backup software	Free
8.	Bluetooth module	30
9.	Bootable DVD	30
10.	Bootable OS Flash drive/CD	30
11.	Bread board	25
12.	Bread board / Basic electronics trainer kit	25
13.	Bread board / Digital Trainer Kit.	25
14.	Breadboard	25
15.	C IDE	Free
16.	C/C++ IDE	Free
17.	C/Python IDE	Free
18.	Card reader	50
19.	Circuit Breaker.	25
20.	Computer Networks	1
21.	Computer System Minimum 5th generation with 8 GB RAM and SSD	25
22.	Connecting Wires (FF, FM etc)	10 buses
23.	DC supply (5 V)	25
24.	DC\AC supply	25
25.	Digital clock	3
26.	Digital Multimeter	25

27.	Digital Trainer Kit.	20
28.	DLD trainer	20
29.	Dual trace Oscilloscope 0-20MHZ	20
30.	DVD or BLU-RAY writer	25
31.	Electrician Tool kit.	1
32.	ESP32	25
33.	External Hard disks	5
34.	Flash Drive	5
35.	Function Generator	25
36.	Hard Disk drives and Solid State disks.	25
37.	Instructional manual	5
38.	Insulation remover	25
39.	Internet	1
40.	Java IDE	2
41.	Keyborad	25
42.	Lamp holder	120
43.	Laptop	01
44.	Load (Lamp)	120
45.	Logic Probe.	5
46.	LoRA concentrator board	5
47.	LoRa module	5
48.	Manageable switch	4
49.	Mass Storage	5
50.	Modem/DSL	2
51.	Mouse	25
52.	MQTT broker	25
53.	MS Office	2
54.	MS Power BI	2
55.	Multi Meter	5
56.	Multimedia projector	1
57.	Networking Devices (Router, Modem, Hub, Firewall, Access Points, Switches etc)	2 Sets

58.	Networking Tool Kit	4 kits
59.	NFC	4
60.	Nodemcu Board	4
61.	NodeMCU module	4
62.	Nose Plier	25
63.	Office Suit	2
64.	OS Bootable Mass storage device	2
65.	Oscilloscope	5
66.	Pi Controller	50
67.	Plier	50
68.	Potentiometer	5
69.	Printer	2
70.	Projector	01 for each lab/class
71.	Projector screen	01 for each lab/class
72.	Python IDE	2
73.	RAID	2
74.	RAID card	2
75.	RAM	2 of each type
76.	RapidMiner (CD/Mass Storage)	2
77.	Raspberry Pi Adapter (5V, 2A)	4
78.	Raspberry Pi module	4
79.	Raspberry pi	4
80.	RFID antennas	2
81.	RFID reader	2
82.	Rheostat	2
83.	ROM	5
84.	Router	4
85.	Router software/Firmware.	2
86.	RS232 interfaces	25

87.	Scanner	2
88.	Screw	5
89.	SD card	5
90.	SD card reader	5
91.	Series board.	25
92.	Server machine	1
93.	Signal generator	5
94.	Simulator (Packet Tracer)	2
95.	Smartphone	2
96.	Software Development kit	2
97.	Software for Software based RAID.	2
98.	Software to test network.	2
99.	Solder	5
100.	Source of data sheets	2
101.	SPI Interface	5
102.	Step down Transformer	25
103.	Step down Transformer (Normal and center tapped)	25
104.	System (Windows, Linux)	2
105.	Tool kit.	5
106.	Trainer	5
107.	Troubleshooting software.	2
108.	UART transmitter	120
109.	USART transmitter	5
110.	USB micro cable	5
111.	USB mini cable	5
112.	Valid public cloud subscription	1
113.	Voltmeter	12
114.	VPN software.	2
115.	Vulnerability scanning tool	2
116.	Webcam	2
117.	Webcam (digital camera)	2

118.	Weka Software (CD/Mass Storage)	01
119.	White board	1 each class/lab
120.	Wifi module	5
121.	Wifi router	02
122.	Wire Tester	02
123.	Wireless router	02
124.	ZigBee modules	5

## List of consumable supplies

1. Note books
2. Inventory registers
3. Pen
4. Pencils
5. Sharpeners
6. Erasers
7. White board markers (Different colors)
8. A4 papers
9. Valid cloud subscription
10. LEDs
11. Female to female header wires
12. Male to female header wires
13. Jumper wires
14. Resistances, capacitors, diodes, zener diode, relays, transistor etc.
15. PVC wires
16. Digital gates
17. Diac,
18. Triac,
19. FETs
20. RJ 45,
21. Category 5 &6 cable
22. Coaxial cable
23. DVD RWR
24. Soldering wire
25. Soldering paste
26. Two way switch
27. One way switch
28. AND gate (7408 2-input Quad)
29. Coupling capacitors
30. DIAC
31. Diodes
32. FET (JFET/MOSFET)
33. Humidity Sensor
34. IC 74147
35. IC 7445 BCD to decimal decoder
36. Inductors
37. Lamp
38. LM741 IC
39. Load (LED)
40. MOSFET
41. NAND gate (7400 2-input Quad)
42. Network cable CAT5,CAT6
43. NOR gate (7402 2-input Quad)
44. Power diodes (general purpose, Fast recovery & Schottky)
45. Push Button
46. PVC Pipe/Duct.
47. Resistive load
48. RFID tags
49. Safety procedures

50. Safety signs
51. SCR
52. Seven segment display
53. Single pole switch
54. Socket
55. Solenoid Valves
56. Temperature Sensor
57. Test Indicator.
58. TRIAC
59. UJT
60. White Board marker
61. Wooden/PVC board.
62. X-NOR gate (74266 2-input Quad)
63. X-OR gate (7486 2-input Quad)
64. Zener Diode
65. IR Sensor
66. IR Ultrasonic Sensor
67. NOT gate (7404 Hex NOT gate)
68. NOT gate (7404 Hex)
69. Occupancy Sensor
70. One 7404 IC – hex inverter (NOT gate)
71. OR gate (7410 3-input)
72. OR gate 7432 2-input Quad



## Credit values

The credit value of the National Certificate Security Services is defined by estimating the amount of time/ instruction hours required to complete each competency unit and competency standard. The NVQF uses a standard credit value of 1 credit = 10 hours of learning (Following Higher Education Commission (HEC) guidelines.

The credit values are as follows:

Competency Standard	Estimate of hours	Credit
Interface sensors and actuators	97	9.7
Apply microcontroller interfacing protocols	87	8.7
Configure ADC & PWM of a controller	57	5.7
Identify and interface short range wireless technologies (Wifi, Bluetooth, RFID, Zigbee, BLE) with the microcontrollers	118	11.8
Program basic building blocks using C/	298	29.8
Program different applications in Arduino, Raspberry Pi, NodeMCU	103	10.3
Perform Arduino, Raspberry Pi, NodeMCU Interfacing with sensors	116	11.6
Perform socket programming	91	9.1
Develop mobile apps using MIT APP Inventor	130	13
Develop a smart home based project	73	7.3
Work in team	30	3