National Institute of Electronics and Information Technology, Aurangabad

COURSE DETAILS

Name of the Course: PG Diploma in Internet of Things (IoT)

Duration: One year

Course Code: ED100

Need for the new course:
The digital space has witnessed major transformations in the last couple of years and as per industry experts would continue to evolve itself. The latest entrant to the digital space is the Internet of Things (IoT). IoT can also be defined as interplay for software, telecom and electronic hardware industry and promises to offer tremendous opportunities for many industries. The number of Internet-connected devices (12.5 billion) surpassed the number of human beings (7 billion) on the planet in 2011, and by 2020, Internet-connected devices are expected to number between 26 billion and 50 billion globally. Therefore to leverage India's strength as a leader in the global service industry, through suitable promotion and supportive mechanisms the draft IoT policy has been formulated to create IoT eco-system in the country. The Indian Government's plan of developing 100 smart cities in the country, for which Rs. 7,060 crores has been allocated in the current budget could lead to a massive and quick expansion of IoT in the country. Also, the launch of the Digital India Program of the Government, which aims at 'Transforming India into Digital empowered society and knowledge economy' will provide the required impetus for development of the IoT industry in the country. The various initiatives proposed to be taken under the Smart City concept and the Digital India Program to setup Digital Infrastructure in the country would help boost the IoT industry. IoT will be critical in making these cities smarter. Aurangabad has been listed in the smart cities.

Objective: T
he course is planned to cover topics that are designed to impart specific knowledge related with the domain of Internet of Things (IoT) so that a fresh graduate / diploma holder who is undergoing the program will get exposed to IoT architecture. The candidate will work on IoT hardware platforms used and associated software, building wireless sensor networks, accessing things through networks, gateways and interfacing with cloud. This will give a chance for the participant to prepare for jobs in leading companies/ industries/ research and development organizations that are dealing with IoT related projects.

Outcome of the Course: On completion of the Course participants shall learn

a) skills on specific hardware and software used in the development of IoT devices
b) working with Arduino, Raspberry Pi & Wireless Modules used in IoT devices
c) embedded Linux used for IoT development
d) C and Python Programming
e) PHP programming for web interfaces

f) IoT Protocol, Networking and Data Transfer
g) IoT networking like wireless sensor networks with Zigbee andWiFi
h) about interfacing IoT with Cloud
i) IoT Security & Platforms

Course Structure:

One year PG Diploma in IoT

Sl. No.	Modules	Min: No. of Hours Theory/Practical
1.	***Introduction to IoT& Microcontrollers***	30/30
2.	***Embedded Linux & C***	40/40
3.	***Python Programming***	20/20
4.	***Arduino, Raspberry Pi & Wireless Modules***	40/40
5.	***Interfacing Sensors & Actuators***	30/30
6.	***Web interface with PHP& MySQL***	50/50
7.	***IoT Protocols, Zigbee& WSN***	40/40
8.	***IoT Data management & Mobile/ Cloud Interface***	40/40
9.	***IoT Security& Platforms***	40/40
10.	***Soft Skills and Personality Development***	10/10
11.	***Project Work***	320
Total Theory / Lecture Hours:		**340 hrs**
Total Practical/ Project / Tutorial Hours:		660 hrs
Total Hours:		**1000**hrs

Week 1-3–Module1: Introduction to IoT& Microcontrollers (60hrs)
Internet of Things (IoT), common definition and concepts, applications, functional view and networking technologies.
Need to learn about Microcontroller, What is Microcontroller?
Difference between Microprocessor and Microcontroller
Types of Microcontroller, MCS 51 Family of Microcontroller, Features of 8051 Microcontroller, Block diagram of 8051 Microcontroller, Pin configuration of 8051 Microcontroller
Architecture-Registers, on chip data/program RAM,SFRs, Port structure, programming ports
Timer programming, interrupt programming
Interfacing to external memory, Real world interfacing LCD, ADC, Keyboard etc.,
Introduction to 32-bit Processors, The ARM Architecture, Overview of ARM, Overview of Cortex Architecture, Cortex M3 Register Set and Modes, Cortex M3

Processor Core, Data Path and Instruction Decoding, ARM Cortex M3 Development Environment.
Cortex M3 based controller architecture, Memory mapping, Cortex M3 Peripherals – RCC, GPIO, Timer, System timer, UARTs, LCD, ADC, Cortex M3 interrupt handling
Basics of hard ware boards Arduino and Raspberry used for IoT applications

Week 4-7–Module2: Embedded Linux & C (80 hours)
Linux OS basics, distributions, File system and commands, administrative and networking essentials,
Linux internals, networking and libraries, package management, working with target boards, BSPs and peripheral management.
C/ C++ programming interfaces, vi editor.
Introduction to 'C' programming, Storage Classes, Data Types, Controlling program flow, Arrays, Functions, Memory Management, Pointers, Arrays and Pointers, Pointer to Functions and advanced topics on Pointers, Structures and Unions, Data Structures, Linked List, Stacks, Queues, Conditional Compilation, Pre-processor directives, File operations, Variable arguments in Functions, Command line arguments, bitwise operations, Typecasting.

Week 8-9–Module3: Python Programming (40 hours)
Basics 1, Installing Python IDE , A first program, Typing things in
Getting input , Printing, Variables, For loops , The loop variable
The range function, Numbers , Math Operators, Order of operations
Random numbers , Math functions, Conditional operators, elif
Miscellaneous Topics , Counting, Summing, Swapping , Strings
The in operator, Indexing, Lists, While loops, Text Files, Functions

Weeks 10-13–Module4: Arduino, Raspberry Pi & Wireless Modules (80 hours)
Installing the Integrated Development Environment (IDE) for Arduino boards
Setting up the Arduino Board, using Mathematical Operators, Serial Communications
Simple Digital and Analog Input, Getting Input from Sensors
Visual Output using LEDs
Physical Output- controlling the Position of a Servo 292
Playing a Simple Melody, Using Time and Dates and using a Real-Time Clock 415
Communicating Using I2C and SPI
Wireless Communication
Sending Messages Using Low-Cost Wireless Modules
Syllabus on Raspberry Pi: Setting up Pi: Features of available Raspberry Pi models. Accessories required to have a Raspberry Pi working system.
Selecting an OS and writing a micro SD card with NOOBS (New Out Of the Box Software).
System Setup and settings in raspi-config.
Working with Pi GUI system. Camera installation.
Advance Python: sending an email from Python, writing a simple web server in Python, delay programs.
Computer Vision, its installation and working with Pi Camera module, face detection, motion detection etc.

Hardware Basics: GPIO pin outs. Safety steps when working with GPIO pins.
Working with I2C, setting up SPI, access to serial port from Python.
Bread boarding with GPIO pins, Converting 5 V to 3.3 V. Controlling Hardware, connecting an LED. Keeping GPIO pins in safe state.
Use of Pulse Wide Modulation for controlling the intensity of LED.
Connecting an audio speaker.

Week 14-16–Module5: Interfacing Sensors & Actuators(60 hours)
Detecting movement using PIR sensor. Connecting GPS to Pi.
Using RTC module. Measuring light intensity with Pi. Measuring temperature with thermistor. Measuring temperature with digital sensors. Measuring acceleration with an MCP3008 Module. Displaying sensor values. Data logging to a USB flash drive. Displaying messages on LCD.

Switching a high power device using relays and MOSFETs.
Controlling a motor. Making user interface to control motors and LEDs with PWM. Controlling the speed of DC motors. Controlling the direction of DC motors.
Controlling unipolar stepper motor. Controlling bipolar stepper motor.
Building a simple Robot. Using external pull up resistors to input pins.

Week 17-21–Module6: Web interface with PHP& MySQL (100 hours)
Fundamentals of networking and protocols, TCP/IP Protocol stack, IPv4 & IPv6 basics, TCP,UDP Protocols & Socket Programming. Client Server architecture.

Networking in Pi wired or wireless.
Controlling Pi remotely with SSH, VNC etc.
Setting Up an Arduino to Be a Web Server, Remotely Controlling External Devices
Controlling GPIO outputs using a web interface. Displaying sensor reading on a web page.
Introduction to MySQL including how to getstarted with your own IOT data through database and code examples.
How to create an environment to run your MySQL database, connect to the database, and delete the DB instance.
Building Low-Cost MySQL Data Nodes, high availability features of MySQL, High Availability IOT Solutions and fault tolerance for datacollectors.

Week 22-25 – Module7: IoT Protocol, Zigbee& WSN (80 hours)
Basics of wireless communication, WLAN(IEEE 802.11)
Wireless Sensor Networks (WSN)
Introduction to Sensor Networks
WiFi and Zigbee
Examples and topology
Wired and wireless, types of sensor nodes
Sensor basics, analog and digital examples
Xbee wireless modules
Interacting with an Xbee-ZB module and configuring
Zigbee networks and updating firmware

Loading firmware for the modules
Configuring coordinator and router
Building and testing aXbee-ZB Mesh Network
Building and testing an Arduino based sensor node
Using Arduino as a data collector for Xbee sensor nodes
Building sensor nodes with Raspberry Pi
Hosting sensors with Raspberry Pi – Hardware setup and programming
Creating a Raspberry Pi Data Collector for XBee sensor nodes
Storing sensor data in non-volatile memories
Writing data to files

Week 26 -29: Module8- IoT Data management &Mobile/ Cloud Interface (80 hours)
Storing data in the cloud and plotting data with an Arduino/ Raspberry Pi
Basics of MQTT and CoAP protocols
Overview of MQTT protocol and message brokers
Storing sensor data in a database server
Set up, operate, and scale a relational database in the cloud.
Storing IOT data in a database such as implementing annotations and aggregationsin the database
Distributed IoT,
Data collectors, Data storage, Data aggregators, actionable devices, Dabase servers
Basic of reliable shared storage and analysis systems, Hadoop, HDFS and MapReduce.
Creating android application using MIT Appinventor. Build Custom Android App for Arduino using MIT App Inventor

Week 30-33: Module9 - IoT Security& Platforms (80 hours)
IoT security basics and design challenges
Security mechanisms for MQTT and CoAP protocols
Securing IoT applications, User ID/Password authentication
One time password (OTP) authentication, Server unique ID authentication
Message payload authentication, SSL/TLS, Device aurhentication, Advanced security policies
IoT platforms overview – IBM WATSON, AMAZON WEB SERVICES (AWS), CARRIOTS
Case Studies on various IoT applications like Home Automation, Health Care, smart cities, etc.,

Week 34: Module10 - Soft skills, Personality Development (20 hours)

Week 35 onwards: Module11: Project Work (320 hours)
Practical implementation of concepts studied for realistic applications is a major part of this course. Students can decide and start working on a particular idea at a very early stage and can start implementing it side by side with course work in addition to the project allotted time.

Evaluation: Assessment of each module/ sub module has theory and lab part. Details of marks distribution is as follow:

The theory exam would be of 50 marks & the practical exam would be of 100 marks. To pass the course, 50% marks are required in both theory and practical component in all modules.

The duration of each practical examination shall be of three hours including viva-voce and maximum marks in each practical examination shall be 100. Students shall be awarded marks to be uploaded by the examiner soon after the examination. Every candidate has to pass in both Theory and Practical Examinations separately, where the **passing marks are half of the maximum marks**.

Pass Percentage:To qualify for a pass in a module, a candidate must have obtained at least 50% in each theory and practical examination. The marks will be translated into grades, while communicating results to the candidates. The gradation structure is as below:-

Pass percentage	Grade
Failed (<50)	F
50%-55%	D
55%-65%	C
65%-75%	B
75%-85%	A
85% and over	S

Course Fees:
General Candidates: Course fee is ₹ *60,000*

Modular wise Course Fee: Not Applicable for this course

Registration Fee: An amount of ₹ 500/- should be paid at the time of registering for the course. The same will be considered as caution deposit on student joining the course. This advance deposit will not be refunded for a selected candidate who does not join the course.

Number of Seats: 30

Eligibility:

A: Graduate/ Diploma

B: i) *Graduate/ Diploma in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/ Instrumentation/ Biomedical/ Computer Science/ Information Technology or MSc in Electronics/ Instrumentation/ Computer Science/ Information Technology.*

ii) *Candidates who have appeared in the qualifying examination and awaiting results may also apply.*

On the date of counseling/admission, the candidate must produce the original mark lists up to the last semester/year of examination.

On the date of counseling/ admission, final year students have to produce the originals of course completion certificate & mark lists up to and including the last semester/ year examination. Only those candidates who have passed all the semesters/ year examinations of their qualifying degree on or before the date of counseling are eligible for admission. The PG Diploma certificates shall be issued to only those who produce the original or provisional degree certificate, the original mark lists and complete all the modules of the program successfully as per the course requirements.

How to Apply:
Students are advised to apply online or in the prescribed Application Form available with the course brochure/ course prospectus or downloaded from our website. Filled-in application forms along with a Demand Draft (or proof of payment through any of the following modes) towards advance fee of ₹ 500/- *drawn in favor of* ExecutiveDirector, NIELIT, Aurangabad, *Payable at* Bank of Maharashtra, Dr B A M University Campus Branch, Aurangabad should be sent to the **Training Officer, NIELIT, Dr B A M University Campus, Aurangabad – 431 002, Aurangabad, Maharshtra.The Name of the Course applied for should be super scribed on the top of the cover in which the application form is forwarded.**

₹ 500/- will be considered as refundable caution deposit on student joining the course. This advance deposit will not be refunded for a selected candidate who does not join the course.

Selection of candidates:
Selection of candidates who have the requisite qualifying degree will be based on the percentage of marks in their qualifying degree subject to eligibility and availability of seats. Selection of candidates who have completed the course but expecting the results shall be based on the aggregate percentage of marks mentioned in their final mark list and on the availability of seats. In case the aggregate percentage of marks is not given in the final mark list, the sum of marks from the first to last for all the semesters/ years shall be considered as the aggregate marks. The selection lists are prepared based on the details given by the applicant at the time of submitting the application.