

NSQF Qualification File – IoT Data Analysis

Detailed Curriculum

Section-1

Detailed Syllabus of Course

S. No	Module Title	Topics	Duration (Hours)		Learning Outcome
			Theory	Lab	
1.	Introduction to IoT & Python Programming	<ul style="list-style-type: none"> • Introduction to IoT: ✓ Evolution of IoT, History & trends that have led to IoT, Applications and Use Cases of IoT , Reference Architecture of IoT, layers and protocols • Introduction to Linux Operating System: ✓ Basics of Linux OS, File System & Management Process ✓ Intro to Text based (shell) & GUI based interface for Linux distribution. • Python Programming Fundamentals: ✓ An Introduction to Python ✓ Beginning Python Basics ✓ Python Program Flow ✓ Functions & Modules ✓ Exceptions Handling ✓ File Handling ✓ Classes in Python 	40	30	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Understand the evolution of IoT, reference architecture, building block and challenges • Capable of Programming with Python • Able to understand the Object-Oriented Programming concepts
2.	Programming with MCU	<ul style="list-style-type: none"> ✓ Introduction to ARM microcontroller Families - Overview of ARM architecture ✓ Programming model, operation modes, Memory model, ✓ Bus Interface, Clock, Low power modes, Interrupt handling ✓ I/O Interfaces, Application development with ARM controllers. ✓ Serial protocols - UART, SPI, CAN and I2C 	30	20	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Develop Embedded application using python • Interface Peripherals with ARM Microcontrollers using SPI/I2C & CAN protocols

3.	IoT Network & Wireless Communication	<ul style="list-style-type: none"> ✓ IoT Communication Models ✓ TCP/IP Stack ✓ IoT Layer Protocols ✓ Wired & Wireless Networks ✓ Network Topologies ✓ Common Network Standards- 802.11 & Variants, 802.15 & Variants ✓ Contiki OS and 6 LoWPAN – Bridging IPv4 with IPv6 ✓ Bluetooth ✓ Communication Models ✓ Data Exchange Format ✓ Application Protocols – CoAP, MQTT ✓ Edge Computing 	30	25	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Understands the IoT layer protocols, standards and topology' • Simulate networking protocols for wired and wireless networks.
4	IoT GUI Development & Cloud Services	<ul style="list-style-type: none"> ✓ Introduction to web application development ✓ Server side vs Client side programming ✓ HTML programming and HTML5 features ✓ CSS Introduction ✓ IoT Application Development using react.JS ✓ Database Management using node.JS ✓ Cloud Computing – IaaS, PaaS, SaaS ✓ Types of Cloud Deployment Models – Private, Public, Hybrid, Community 	35	35	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Develop the applications for edge devices • Deploy Different Types of Cloud for IoT Applications
5.	Statistical Concepts	<ul style="list-style-type: none"> ✓ Descriptive & Inferential Statistics, Probability Concepts ✓ Random Variable, Distribution Functions (Discrete and Continuous), Measure of Central Tendency, Deviations, Central Limit Theorem, Proportions, Covariance, Correlation, Estimation, Interval Estimation 	25	10	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Understand the mathematical principles required for Data Analytics and Machine Learning.

6.	Data Analytics	<ul style="list-style-type: none"> ✓ An Introduction to Data Science and Analytics ✓ Data Analysis Using NumPy ✓ Data Analysis Using Pandas (Series & DataFrame)- Data Cleaning, Missing Data, Feature extraction ✓ Data Visualization – Static, Dynamic & Geographical Visualization 	20	30	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Able to use NumPy for Numerical Data • Able to use Pandas for Data Analysis • Able to use Data Visualization tools for interactive dynamic visualizations
7.	Machine Learning	<ul style="list-style-type: none"> ✓ Linear Regression, Supervised Learning (Classification) and Unsupervised Learning (Clustering) algorithms. ✓ Time Series Analysis- (Data Resampling, Data Shifting, Rolling & Expanding), Time Series Forecasting 	20	35	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Implement the various Machine learning algorithm using scikit-learn library library on Python.
8.	Project	<ul style="list-style-type: none"> ✓ Done as a group project where the trainees will be working on a real life problems sourced from industry/ start-ups. 	0	115	<p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> • Develop a complete working product /project.
Total Hours = 455			200	300	

Recommended Hardware:

- Development Boards - Raspberry Pi
- Sensors–PIR, Ultrasonic, LDR, Soil Moisture, Flame, Accelerometer & Gyro meter
- Camera Module, Sense Hat, Capacitive Touch Screen
- Wireless Sensor Network Radio and Related Modules with Integrated Antenna
- Aardvark I2C/SPI Host adapter, I2C/SPI development board, CAN Development board, Komodu CAN Duo Interface
- Virtual Lab setup for cloud software's and remote access.

Recommended Software:

- Ubuntu / Raspbian
- Brackets
- Visual Studio
- Sublime text
- Anaconda environment

Text Books:

- Let us C by Yashwant Kanetkar.
- The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes.
- Make: Getting Started with Raspberry Pi:
- PHP for the Web: Visual QuickStart Guide by Larry Ullman
- HTML & CSS -Design and Build Websites by Jon Ducket
- Practical Statistics for Data Scientists – By Peter Bruce and Andrew Bruce
- Introduction to Machine Learning with Python: A Guide for Data Scientists – By Andreas C. Müller and Sarah Guido
- Python Data Science Handbook – By Jake VanderPlas
- Learning Node.js Development: Andrew Mead
- React.js Essentials: Artemij Fedosejev

Reference Books:

- Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill.
- Embedded C, Pont, Michael J
- Embedded Systems an Integrated Approach: Lyla B Das, Pearson
- C Programming by Worthington, Steve
- Assembly language Programming ARM Cortex-M3, Vincent Mahout, Wiley
- Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig.
- ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.
- Cortex M3 Reference manual.
- STM32Ldiscovery datasheets, reference manuals & Application notes.
- HTML5 Black Book
- Essential Math for Data Science: Calculus, Statistics, Probability Theory, and Linear Algebra, by Hadrien Jean
- Build a Career in Data Science, by Emily Robinson and Jacqueline Nolis
- Data Science for Dummies (2nd Edition), by Lillian Pierson
- The Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani and Jerome Friedman

Section 2

TRAINER PROFILE

Level: 5

Batch Size: 20 students

No of Trainers: 1

No of demonstrators: 1

Education Qualification	<ul style="list-style-type: none"> • B.E./B. Tech in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics & Instrumentation / Instrumentation & Control /Biomedical /Computer Science/Information Technology
Experience	<ul style="list-style-type: none"> • Minimum 1 year of experience in the field of IoT/Embedded programming
Technical Skills	<ul style="list-style-type: none"> • Hands-on Experience in ARM Cortex M4 Programming • Expertise in Interfacing Sensors & Peripheral • Development of Internet of Things Application • Able to Analyze and Process the Data • Able to use Data Analytics & Machine Learning tools: Numpy, Panda, Scikit-learn for various applications • Build Real-time application using RTOS • Porting RTOS to ARM Cortex Microcontrollers • Developing Device Drivers for Embedded Linux Application • Industrial level hands-on experience through various projects
Other Skills	<ul style="list-style-type: none"> • Should be able to communicate well in English • Good command on regional language • Knowledge of working on computers • Should be able to prepare lesson plan, deliver the courses through the specified media as per schedule • Should be able to inspire the trainees & evaluate and assess the trainees • Should be able to monitor progress and give feedback to trainees • Should be able to maintain MIS related to training