Syllabus of

Post Diploma

in

Embedded Systems and IoT

ES100

(Online mode)

Duration	360 Hours (24 weeks)
Course code	ES100
Eligibility	Diploma in Electronics / Communication / Instrumentation / Electrical or Equivalent or B.Sc. (Electronics) from a Recognized University
Course Fee for	Rs.8000/- (Excluding Tax)

Course Structure

Module Code	Subject	Duration (Hours/Weeks)
ES- 101	Embedded 'C'	72/4
ES -102	ARM Cortex Microcontrollers	72/4
ES -103	Embedded Protocols	72/4
ES -104	Internet of Things	72/4
ES -105	Project work	72/8
	Total	360 / 24

Objective of the Course:

Post Diploma in Embedded System Design & IoT Course is intended to impart skills essential for the design and implementation of Embedded and IoT systems using appropriate hardware and software tools. This course offers a range of topics of immediate relevance to industry and makes the participants exactly suitable for Embedded and IoT Industry.

Outcome of the Course:

- Provide the participants in-depth knowledge and skills required by Embedded System and IoT Companies around the globe by imparting comprehensive understanding about the fundamental principles, methodologies and industry practices.
- Makes the successful participants readily employable in multiple roles available in Embedded and IoT Industry

- Enhances the skillsets and confidence for Embedded Start-ups

Duration: 360 Hours

Target Audience: Diploma Completed of the following branches. Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Biomedical /Computer Science/Information Technology.

Prerequisite: Knowledge of analogue and digital Electronics Fundamentals, C Programming and Microprocessors/ Microcontrollers are desirable.

ES 101: Embedded 'C'

Module Duration: 72 Hours

Objective

This module aims at familiarizing the students in embedded concepts, programming in 'C'. This module covers the introduction to embedded systems and advanced topics in 'C' such as Memory management, Pointers, Data structures which are of high relevance in embedded software is considered in depth.

Learning Outcomes

After successful completion of the module, the students shall be able to understand:

- Development of Embedded applications using Embedded C

Course Description

Embedded Concepts

Introduction to embedded systems, Application areas and categories of embedded systems, Overview of embedded system architecture, Specialties and trends in embedded systems, Development and debugging Tools.

'C' and Embedded C

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, Variable arguments in Functions, Command line arguments, bitwise operations.

Text Books:

1. Let us C by YashwantKanetkar.

Reference Books:

1. 'Embedded C, Pont, Michael J
2. C Programming language, Kernighan, Brian W, Ritchie, Dennis M
3. Art of C Programming, JONES, ROBIN,STEWART, IAN

ES 102: ARM Cortex Microcontrollers

Module Duration: 72 Hours

Objective

This module aims at familiarizing the students in embedded concepts, programming in 'C' and ARM Architecture. This module also covers the Architecture of ARM and application development with ARM Cortex Microcontrollers.

Learning Outcomes

After successful completion of the module, the students shall be able to understand:

- Development of Embedded applications using Embedded C
- Usage of ARM Cortex Microcontrollers with Embedded C, Programming for Application Development.

Introduction to ARM Cortex Architecture

Introduction to ARM Architecture, Overview of ARM, Overview of Cortex-M Architecture

Cortex M3 Microcontrollers & Peripherals

Cortex M3 based Microcontroller architecture, Memory mapping, ARM Cortex M3 Peripherals – GPIOs, Timers, UARTs, Cortex M3 interrupt handling (NVIC), ARM Cotex-M3 Programming and application development.

Text Books:

- Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK.
- The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes.

Reference Books:

1. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill.
2. Embedded Systems an Integrated Approach: Lyla B Das, Pearson
3. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.
4. ARM Cortex M3 Reference manual.
5. STM32xx Development board datasheets, reference manuals & Application notes.

ES 103: Embedded protocols

Module Duration: 72 Hours

Objective

This module aims at familiarizing the students in interfacing sensor with microcontrollers. This module covers the popular embedded protocols like USART/I2C/SPI and USB.

Learning Outcomes

After successful completion of the module, the students shall be able to understand:

- Interfacing of sensors for with microcontrollers that facilitates Embedded applications development.
- Usage of ARM Cortex Microcontrollers/Arduino with Embedded C, Programming for Application Development.

Introduction to Embedded Protocols

Introduction to Embedded protocols - USART/I2C/SPI and USB. Comparison of these protocols.

Arduino programming

Introduction to Arduino. Configuring Arduino for different hardware platforms. API used with Arduino. Introduction to sensors and interfaces.

Text Books:

- Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK.

Reference Website:

https://www.nxp.com/docs/en/application-note/AN10216.pdf

https://learn.sparkfun.com/tutorials/i2c/all

ES 104: Internet of Things

Module Duration: 72 Hours

Objective

This module aims to build participants who can specify, design, and program modern connected electronic systems in response to the ever-growing number of connected devices.

Learning Outcomes

After successful completion of the module, the students shall be able to understand:

- Internet of Things (IoT) fundamentals
- IoT and embedded system architectures
- Connectivity and networking technologies

Course Description

Embedded and IoT Overview

Introduction to IoT, Overview and Layering Concepts in IoT.

Overview of IoT hardware platforms, Introduction to various IoT Standards, Peripheral Programming with Arduio/NODEMCU. Python programming for Raspberry Pi and interfaces,

Wireless connectivity standards for IoT, Bluetooth, ZigBee, Wi-Fi standards. IoT protocol architecture, IoT application layer protocols- MQTT. Open source and commercial cloud for IoT, Device management platform.

Text Books:

1. The Definitive Guide to the ARM Cortex M3 and M4 Processors, Joseph Yiu, Newnes.
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. OvidiuVermesan, Dr. Peter Friess, River Publishers

Reference Books:

1. Getting Started with Bluetooth Low Energy, Tools and Techniques for Low-Power Networking, By Kevin Townsend, Carles Cufí, Akiba, Robert Davidson
2. Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed, By Perry Xiao
3. Internet of Things (A Hands-on-Approach), Vijay Madisetti , ArshdeepBahga
4. ARM Cortex M3 Reference manual.

ES 105: Project Work

Module Duration: 72 Hours

Objective

The objective of project work is to demonstrate the candidates' skill and knowledge in solving a real work Engineering problem involving Embedded or IoT System Design.

Learning Outcomes

After successful completion of this module, the participant shall be able to:

- Undertake and indecently complete a real world Industry problem involving Embedded or IoT System Design using state of the art industry standard tools and practices.

Description

The participants can choose projects involving one among the following;

Embedded System/ Product Design with ARM Microcontrollers/ARM SoCs, IoT Application Development etc.

Assessment Evidence

Sl.No	Module Title	Duration (Hours)		
		Theory (hrs/credits)	**Practical (hrs/credits)**	**Total (hrs/credits)**
1	Embedded 'C'	24/1.5	48/1.5	72/3
2	ARM Cortex Microcontrollers	24/1.5	48/1.5	72/3
3	Embedded protocols	48/3.0	24/1.0	72/4
4	Internet of Things	24/1.5	48/1.5	72/3
5	Project	0	72/2	72/2
	Total Duration	120/7.5	240/ 7.5	360/15

Examination Pattern

Sl No	Description of evaluation	Modules Covered	Duration in Minutes	Maximum Marks
1	Theory Paper – 1	1,2	60	100
2	Theory Paper – 2	3,4	60	100
3	Practical -1	1,2	180	100
4	Practical -2	3	180	100
5	Practical -3	4	180	100
6	Internal Assessment	All modules	-	50
7	Project/Presentation /Assignment	All Modules	-	150
	Total			**700**

Means of Assessment:

Online assessments carried out for 2 theory and 3 practical of respective modules using a variety of question formats applicable for the course.

Pass/Fail

Following Grading Scheme (on the basis of total marks) will be followed:

Grade	S	A	B	C	D	Fail
Marks Range (in %)	≥85%	>=75% &<85%	>=65% &<75%	>=55% &<65%	>=50% &<55%	<50%

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 Both Theory and Practical examination will be in online mode.

 Online Theory Examination will have Multiple Choice Questions (MCQs).

 There is no negative marking in Online Theory Examination

Mode of conduction (Theory)

Conducted Online mode contains live sessions/recorded videos and demonstrations

Mode of conduction (Practical)

Modules	Module Name	Mode	Remarks
1	Embedded 'C'	Linux PC or Virtual machine of participant	GCC Compiler
2	ARM Cortex Microcontrollers	Simulation & h/w debugger	Keil MDK- Open source STM32xx Development board with ST-Link * Debugger
3	Embedded protocols	Demonstration/Simulation & h/w debugger	NODEMCU Development Board and sensors *
4	Internet of Things	Demonstration/ Remote lab	Using remote lab for RPi and NODEMCU

*To be procured by the participant