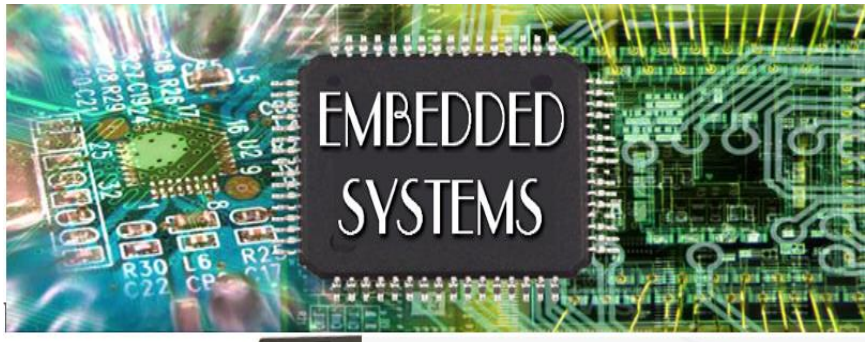
معهد بحوث الالكترونيات
Electronics Research Institute

www.ERI.sci.eg

2018

Diploma in Embedded Electronics Systems



Dr.eng. Hafez Fouad

Microelectronics Dept.

ERI , Cairo , EGYPT

00201115735550

00201272146620

hafez@eri.sci.eg

hafezfouad@yahoo.com

Professional Instructors:

ERI, ITI, Multinational Co.

Executive Engineer:

Eng. Gamal Yehia

00201156345172

Diploma in Embedded Electronics Systems

http://www.eri.sci.eg/?q=en/embedded-systems-diploma

Course Description:

The aim of this diploma is to give the students a firm grip of the embedded systems design field,make its graduates capable of implementing and executing a full system, including design, software design concepts and rules ,writing well organized code, interfacing with PC, design interface circuits for power applications, performing (proof of concept) POC, design PCB and have the idea realized

Diploma Audience: No. in class : From 12 : to 16 Trainees

Interested, passionate and determined engineers willing to start their career path in the Embedded Systems field from the zero level to advanced level, to be qualified for embedded systems companies all over the world and for those professional in Embedded Systems field and want to increase their scope in this field and learn integrated system design cycle.

Diploma Phases :

The Diploma will be divided into 6 main phases:

Phase -1- Intermediate Phase : ***60 hours***

Course 1: Introduction to Embedded System.(1 day)

Course 2: C Programming, Advanced C. (10 days)

Course 3: Data Structure Theories and algorithms. (3 days)

Course 4: Microcontroller and MicroProcessors Architecture(1 days)

Phase - 2- Advanced Phase : ***92 hours***

Course 5: Software engineering for embedded systems. (2 days)

Course 6: Microcontroller peripherals (3 days)

Course 7: Embedded C programming (8 days)

Course 8: Microcontroller communications (3 days)

Course 9: Interfacing different communication modules (3 days)

Course 10: Controller Area Network CAN (2 days)

Course 11: Introduction to Real-Time Operating Systems (RTOS) (2 days)

Phase 3- Desktop Application Development Phase : *12 hours*

Course 12: **Introduction to C# (3 hours) (1 day)**

Interfacing Serial port using C# (3 hours) (1 day)

Interfacing USB using C# (6 hours) (1 days)

Phase-4: Analogue & Power electronics phase: *16 hours*

Course 13: Signal conditioning, basic small signal transistor circuits, and op-amp circuits. (1 days).

Course 14: Introduction to power electronics components and elements, MOSFETS, BJTs, IGBTs and transistor drivers (1day).

Course 15: Introduction to DIACs, TRIACs, Thyristors (1 day).

Course 16: DC/DC converters ,Inverter , Three phase systems (1 day)

Phase-5: Industry & manufacturing Phase : *12 hours*

- **Prototyping and POC using Proteus**
  - **Introduction to Proteus (1 day)**
  - **Course 17:Basic system simulation using proteus ISIS (1 day)**
  - **Course 18:PCB design using Proteus ARES (1 day)**

Phase 6 : Graduation Project Phase : 1 month

Diploma Benefits :

- **The student will be given a kit from the ERI, where all the examples and applications can be carried out on it, the schematic and layout of this kit will be given to the student.**
- **Topics are selected precisely to meet market requirements.**
- **Topics are selected so as to cover the complete process of designing an embedded systems which in turn helps the graduate to be able to establish a start-up due to the fact he is capable of designing the whole system not just a part of the system as the graduate shall be able to design the software and hardware of the system and connect the system to the PC , thus can finish a whole system without the need of another partner or more courses.**
- **During the project phase, the graduate shall have the accessibility of online consultation with the diploma stuff until the project is delivered and accepted by the ERI.**
- **The ERI shall organize visits to the PCB manufacturing factories in Egypt thus allowing the graduate to understand the needs for each factory and its limitations when designing its PCB.**
- **The graduate shall be given a certificate from the ERI indicating all the experience and knowledge acquired from the diploma.**
- **The graduates shall be given the chance to apply for the ERI incubation project, where good ideas may be realized by this promising program.**

Course Duration: Total: 192 Hours : 48 Days in 16 weeks

Hardware: Using Hardware Kits for practical Interfacing course designed by ERI and manufactured in Egypt.

Diploma Contents in details:

Course 1: Introduction to Embedded System

This course aims to build up an understanding what is Embedded System and applications by explain some important definitions used in this field. Also it will initiate to know different embedded system hardware and brief concepts about embedded system software.

Contents:

- What is Embedded System?
- Embedded System Fields and Applications.
- Important Definitions.
- Embedded System Hardware.
- Embedded System Software.

Objectives:

Student understands what is the difference between embedded system and general programming. Student understand what is microcontroller and main components “Memory, CPU… Embedded software Life-Cycle.

Course 2: C Programming, Advanced C

This course provides students with a comprehensive study of the C programming language to provide programmers with the meanings of writing efficient, maintainable, and portable code.

Contents:

- Ch1: Introduction to C programming
- Ch2: Variables and operators.
- Ch3: Input output functions
- Ch4: Loops
- Ch5: Branching
- Ch6: Function and Macros
- Ch7: Arrays
- Ch8: Pointers
- Ch9: Structures
- Ch10: Dynamic memory allocation.

Course 3: Data Structure Theories and Algorithms.

This course provides more about stack, linked list, queue, searching and sorting algorithms.

Course 4: Microcontroller Architecture & Peripherals.

This course will provide the main principles of microcontroller & its peripherals.

Contents:

- Introduction to computing systems.
- Microcontroller Architecture.
- Instruction Set Architecture.
- Pipelining and memory management.

Course 5: Software Engineering for embedded systems

This course is aimed at helping students build up an understanding of how to develop a software system by guiding them through the development process and giving them the fundamental principles of system development. The course will initiate students to the different software process models, software requirements engineering process, systems analysis and design as a problem solving activity and supporting tools for the software development process.

Contents:

- Introduction to Software Engineering.
- Software Processes.
- Requirements Engineering.
- System Modeling: flow oriented diagrams, behavioral diagrams.
- Supportive process tools.

Objectives:

Develop an understanding of software process models and the ability to select the suitable model to use in software development.

Develop an understanding of requirements engineering process and distinguish between different types of requirements.

Ability to analyze, design and develop the system models using Context Diagrams for software development.

Ability to prepare the software requirements specification document for a software project.
Develop and understanding of software tools like configuration management tools.

Course 6: Microcontroller Peripherals

The course introduces how Microcontroller Interface with surround environment “Inputs, Outputs and external module, ADC, DAC, PWM ,Timer interrupt and most commonly used peripherals.

Contents:

Diploma in Embedded Electronics Systems

The first part of this course aimed at helping students build up an understanding what is Embedded System and applications by explain some important definitions used in this field. The course will initiate students to know different embedded system hardware used in the field and brief concepts about embedded system software.

Objectives:

- How to use DIO “Digital Input Output” driver to interface with.
- Digital Input and Output like “Led, Buzzer and Switches”.
- How to deal with User interface like “Keypad and Character LCD”.
- How to use some internal peripherals like (Timer, Interrupt) and how we use this peripherals in real industry.

Course 7: Embedded C Programming

This course is aimed at helping students build up an understanding of how to write C language for Embedded Systems, it will help to understand some important concepts in c language used in embedded system development.

Contents:

- Development environment
- Preprocessor Directives
- Variables scope and lifetime
- Modeling the software
- Keywords modifiers and startup code
- Interrupts.
- Configuration types

Objectives:

The primary goal of this course is to give the participant the skills necessary to develop software for embedded computer systems using a C programing language .and how to deal with tips and tricks in interviews and how to write software in professional way.

Course 8: Microcontroller communications.

This course mainly aim to understand how Microcontrollers communicate with other devices using standard communication protocols like “USART, SPI, and I2C”.

Contents:

- Write simple and generic driver for USART protocol.
- Write simple and generic driver for SPI protocol.
- Write simple and generic driver for I2C protocol.

Course 9: Interfacing different communications modules.

This course aims mainly to understand how to use modules already existing in the market that allows for more advanced communications like WIFI, Bluetooth or Ethernet, this section will be customized according to group needs

Contents:

- Using WIZNET Ethernet module.
- Using ESP8266 WIFI module.
- Using HC-06 module.

Course 10: Controller Area Network (CAN).

This course aims mainly to understand how data is transferred using CAN bus module, common usage eg. In vehicle industry , then shows how to interface this bus using MCP2515 chip

Contents:

- Introduction to CAN bus.
- Using MCP2515 chip.

Course 11: Real-Time Operating Systems "RTOS".

The course introduces the fundamental elements of real time multitasking embedded application software design and development. Processor and operating system concepts relevant to multitasking systems are examined, with focus on preemptive task scheduling, inter task communication and synchronization. FROTS is used as a case study to illustrate the main concepts of the real time operating systems.

Contents:

- Software Design, Real-Time Systems.
- Task Priority, Priority Inversion, Priority Inheritance.
- Real Time Systems
- Kernel Structure
- RTOS Services, Characteristics of RTOS.
- Kernel, Scheduler
- Tasks status
- Inter task communication (Semaphores, Mutex)

Objectives:

The primary goal of this course is to give the participant the skills necessary to develop software for embedded computer systems using a real time operating system.

Course 12: Desktop Application development.

This course aims mainly to understand how design a simple GUI using C# sharp and communicate with an embedded system using either UART or USB.

Contents:

- Introduction to C#.
- Writing a software for Interfacing UART.
- Writing a software for Interfacing USB.

Course 13: Signal conditioning, basic small signal transistor circuits, and op-amp circuits

This course aims mainly to understand how interface with analogue signals whether for input or output, filter and sample the analogue signals for ADCs or operate a relay, or simple resistive load.

Contents:

- General interfacing and signal conditioning techniques and circuit.

Course 14 : Introduction to power electronics components and elements, MOSFETS, BJTs, IGBTs and transistor drivers.

This course aims mainly to understand how to operate heavy loads that require high voltage and high currents with the microcontroller , using MOSFETs, BJTs, IGBTs and transistor base drivers and protection chips like HCPL316

Contents:

- General understanding of the power transistors operation techniques , and their drivers wiring and configuration.

Course 15: Introduction to DIACs, TRIACs, Thyristors

This course aims mainly to understand how DIACS, TRIACs and thyristors , this section may have a brief understanding of the MOC series DIACs that can interface to microcontroller, and some explanation of the zero crossing detection circuits and their operation

Contents:

- General understanding of the DIACs, TRIACs , and thyristors, MOC DIACs series and zero crossing detection circuits

Course 16: DC/DC converters ,Inverter , Three phase systems

This course aims mainly to understand how DC/DC converters operate , the current flow in inductive loads, Inverters and sine wave forming, and brief introduction to 3-phase systems

Contents:

- General understanding of the DC/DC converters operate , the current flow in inductive loads, Inverters and sine wave forming, and brief introduction to 3-phase systems

Course 17: Basic system simulation using proteus ISIS

This course aims mainly to understand how simulate circuits using proteus ISIS for quick POC and simulation.

Diploma in Embedded Electronics Systems

Contents:

- General understanding of Proteus ISIS software.

Course 18: Basic system simulation using proteus ARES

This course aims mainly to understand how simulate circuits using proteus ARES for quick PCB design and automated routing.

Contents:

- General understanding of Proteus ARES software.

Price : 8000 LE

Discount 25% for 3-y fresh graduates & Students = 6000 EGP

Pilot-Project: *40 hours (10 Days) -* Price: 2000 LE (optional and online)

Project Discount 25% for fresh graduates, Students = 1500 EGP

Industrial Applications : (Healthcare , Automotive , ……).

---------- Dr. Hafez Fouad , ERI , Cairo , EGYPT