Certificate course on Embedded System Design using ARM Cortex M4
(Certified Embedded Programmer)

Preamble:

Now-a-days in our homes, shops, offices, cars, factories, hospitals and consumer electronics there are devises which uses Embedded System Technology. The inherent value of embedded systems lies in its pervasiveness. They are literally embedded in all the electronic products, from consumer electronics to office automation, automotive, medical devices and communications. They make the products smart, connected and are responsible for differentiating the products in the market. These systems are normally built around Microcontrollers and ARM Processor. This course has been designed to meet such technical requirements from the industry.

Objective:

To develop the skill set required for Design and Development of the Embedded System Hardware (Interface / Peripherals) and Software for Embedded Applications / Product in the Industry.

Expected Job Roles:

- Embedded designer
- Embedded Programmer
- Embedded hardware designer
- Embedded software designer

Duration:

120 Hours - (Theory: 40 hrs + Practical: 80 hrs)

Course Outline:

Sl. No	Module Title	Duration (Hours)		
		Theory	Lab	Total
1	Introduction to Embedded System	1	1	2
2	ARM Cortex M4 and TM4C123GH6PM Launch Pad Architecture	2	4	6
3	Embedded C Programming	3	5	8
4	ARM Cortex–M4 Peripherals	10	24	34
5	Interfacing using Embedded Wired Communication Protocol (UART, SPI, I2C)	14	26	40
6	Interfacing using Wireless Communication Protocol (Bluetooth, Zigbee and GSM	10	20	30
	Total Duration	**40**	**80**	**120**
	Total Credits	**3**	**3**	**6**

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Prerequisites:

Knowledge of C Language

Eligibility:

BE / B.Tech Undergoing or above

Detailed Syllabus and Learning Outcome:

S. No	Module Title	Topics	Duration (Hours)		Learning Outcome
			Theory	Lab	
1	Module-1 Introduction to Embedded System	• Introduction to Embedded System. • Introduction to Embedded System Development Process - Tool Chain and Cross Compilation: Text Editors/Compilers/Programmers/ Development tools/IDE, Debugger.	1	1	• To get overview of Embedded System Software development, testing & Verification. • Hands on exposure to the tool Chain utilized in Embedded System Design, Development & Verification.
2	Module-2 ARM Cortex M4 and TM4C123GH6PM Launch Pad Architecture	• Introduction to ARM Cortex M4 microcontroller and TM4C123GH6PM Launch Pad architecture, Programmers Model, Processor Operating States, instruction set etc.	2	4	• Understanding of ARM Cortex-M4 Microcontroller and TM4C123 Launch Pad architecture
3	Module-3 Embedded C Programming	• Introduction to Embedded 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,	3	5	• Embedded C Programming Concepts. • Develop embedded application using Embedded C Programming.

		Linked List, Stacks, Queues, Conditional Compilation, Pre-processor directives, Variable arguments in Functions, bitwise operations, Typecasting.			
4.	Module-4 ARM Cortex–M4 Peripherals	• ARM Cortex–M4 Peripherals-GPIOs, Timers / Counter, PWM; Interrupt handling – NVIC, ADC, Memory, Temperature Sensor, External: Display Devices, Actuators, Real Time Clock, and Sensors.	10	24	• Will be able to Program and interface the peripherals: General Purpose I/O, ADC, Timer / Counter, PWM, DAC, Memory, Real Time Clock, Temperature Sensor etc. to build an embedded system.
5.	Module-5 Interfacing using Embedded Wired Communication Protocol (UART, SPI, I2C)	• Introduction to Serial / Wired Communication Protocols (UART, SPI, I2C) and its standards. • Programming concept for interfaceto Arm Cortex M4 Controller using Wired Communication Protocols.	14	26	• Able to Configure and Program the Controller for interfacing with different Modules / Devices using Serial / Wired Communication Protocols.
6	Module-6 Interfacing using Wireless Communication Protocol (Bluetooth, Zigbee and GSM)	• Introduction to Wireless Communication and its standards -Bluetooth, Zigbee and GSM • Communicating between the Arm Cortex M4 and Wireless Devices (Bluetooth, Zigbee and GSM)	10	20	• Able to interface and transfer & receive data between Bluetooth / GSM / Zigbee modules with ARM Cortex microcontroller.
Total Hours = 120			40	80	

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Examination & Certification:

NIELIT's NSQF Examination pattern will be followed for Examination & Certification.

Sl No	Examination Pattern	Modules covered	Duration in Minutes	Maximum Marks
1	Theory Paper – 1	All 6 modules	90	100
2	Practical -1	All 6 modules	120	60
3	Internal Assessment	-	-	20
4	Project/Presentation /Assignment	-	-	20
	Total			**200**

Note:

1. Pass percentage would be 50% marks in each component, with aggregate pass percentage of 50% and above.
2. Grading will be as under:

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

3. Theory examination would be conducted online and the paper comprise of MCQ and each question will carry 1 marks.
4. Practical examination/Internal Assessment/ Project/Presentation/Assignment would be evaluated internally.
5. Major Project/Dissertation would be evaluated preferably by External / Subject Expert including NIELIT Officials.
6. Candidate may apply for re-examination within the validity of registration.
7. The examinations would be conducted in English Language only.

Recommended hardware/software tools:

1. Code Composer Studio (CCS) IDE
2. Tiva –C Development Board
3. Display Devices (Seven Segment Display, LCD, LEDDOT Matrix,
4. Servo and Stepper Motors
5. Sensors
6. GSM, Zigbee and Bluetooth Modules
7. Protocol Analyser

8. Digital Multimeter & Digital Storage Oscilloscope

Faculty & Support / Lab Instructor:

1. One Faculty with B.Tech/BE in ECE/EEE/ CSE/ M.Sc (Electronics) or equivalent with experience in Embedded Systems Design and Development.
2. One Support / Lab Instructor with at least Diploma in ECE/EEE/ CSE/ B.Sc (Electronics) or equivalent with experience in Embedded Systems Design and Development.

References:

E- Books and Open Source Reference Material available for ARM cortex and TIVA-C

Course Name	Certificate course on Embedded System Design using ARM Cortex M4 (Certified Embedded Programmer)	**Vertical**	Embedded System
Course Code		**Rev No**	R4
Prepared By	Ripunjay Singh	**Proposed NSQF Level**	5
NIELIT Centre	Chennai	**Last Revised on**	03.06.2019