COURSE MODULE

Faculty Name:			Academic Year: **2025-26 (EVEN Sem)**				
Department: **ECE**							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
BEC601	**Embedded System Design**	**Core**	**Microcontrollers basics**	**3**	**-**	**-**	**40 (8 Hours / Module)**

Course objectives: This course will enable students to:

- Identify various components, their purpose, and their application to the embedded system's applicability.
- Program various embedded components using the embedded C program.
- Understand the embedded system's real-time operating system and its application in IoT Understand the fundamentals of ARM-based systems, including architecture and its units like registers, debug interface, stack, MPU, Interrupts etc
- Use the various instructions to program the ARM controller

Topics Covered as per Syllabus

Module-1

Introduction to Embedded System: What is an Embedded Systems? Embedded systems Vs General computing systems, History of Embedded Systems, Classification of Embedded systems, Major Application Areas of Embedded Systems. Purpose of Embedded Systems, The Typical Embedded System, Microprocessor Vs Microcontroller, Differences between RISC and CISC, Harvard V/s VonNeumann Processor/Controller Architecture, Big-endian V/s Little-endian processors, Memory (ROM and RAM types), Sensors & Actuators, The I/O Subsystem – I/O Devices, Light Emitting Diode (LED), 7- Segment LED Display, Optocoupler, Relay, Piezo buzzer, Push button switch, Communication Interfaces, On-board Communication Interface, External Communication Interface, Embedded Firmware, Other System Components

Module-2

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling (excluding UML), Embedded firmware design and development (excluding C language).

Module-3

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock. How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil). (Text 1: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2 , 10.7, 10.8.1.1, 10.8.1.2 only)

Module-4

ARM Embedded Systems: Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions

Module-5

Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load – Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.

List of Text Books

1. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education
2. Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008

List of Reference Books

1. Raj Kamal, “Embedded Systems: Architecture and Programming”, Tata McGraw Hill, 2008.

List of URLs, Text Books, Notes, Multimedia Content, etc

1. https://archive.nptel.ac.in/courses/106/105/106105193/
2. https://developer.arm.com/documentation/dui0068/b/ARM-Instruction-Reference
3. https://www.udemy.com/course/introduction-to-arm-cortex-m3-and-m4-processors/
4. www.Nuvoton .com/websites on Advanced ARM Cortex Processors
5. https://alison.com/tag/embedded-systems

Course Outcomes:

At the end of the course the student will be able to:

CO1: Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.	L2
CO2: Apply the knowledge gained for Programming ARM Cortex M3 for different applications.	L3
CO3: Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system	L3
CO4: Understand the hardware software co-design and firmware design approaches.	L3
CO5: Explain the need of real time operating system for embedded system applications.	L3

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code: **BEC601**	TITLE: **Embedded System Design**	Faculty Name:

List of Course Outcomes	Program Outcomes												Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO-1	3	3	2	-	2	-	-	-	-	-	-	2	**12**
CO-2	3	3	2	-	3	-	-	-	-	-	-	2	**13**
CO-3	3	3	3	-	2	-	-	-	-	-	-	2	**13**
CO-4	3	3	2	-	2	-	-	-	-	-	-	2	**12**
CO-5	3	3	3	-	3	-	-	-	-	-	-	2	**14**
Total	**15**	**15**	**12**	**-**	**12**	**-**	**-**	**-**	**-**	**-**	**-**	**10**	**64**

The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO's)

Subject Code: BEC601	**TITLE: Embedded System design**	

List of Course Outcomes	Program Specific Outcomes		
	PSO1	**PSO2**	**Total**
CO-1	2	1	**3**
CO-2	2	1	**3**
CO-3	2	1	**3**
CO-4	2	1	**3**
CO-5	2	1	**3**
Total	**10**	**5**	**15**

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contrib