COURSE MODULE OF THE SUBJECT TAUGHT FOR THE SESSION 2024-25 (EVEN SEM)

Course Syllabi with CO's

Faculty Name:			Academic Year: 2024 - 2025				
Department: Computer Science & Engineering							
Course Code	Course Title	Core / Elective	Prerequisite	Contact Hours			Total Hrs./ Sessions
				L	T	P	
BCS402	Microcontrollers	Core	Computer Organization	3	0	2	40T+20P
Course Objectives	1. Understand the fundamentals of ARM-based systems and basic architecture of CISC and RISC. 2. Familiarize with ARM programming modules along with registers, CPSR and Flags. 3. Develop ALP using various instructions to program the ARM controller. 4. Understand the Exceptions and Interrupt handling mechanism in Microcontrollers. 5. Discuss the ARM Firmware packages and Cache memory polices.						

Topics Covered as per Syllabus

Module-1

ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions.

Module-2

Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants.

Module-3

C Compilers and Optimization: Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing, Portability Issues.

Module-4

Exception and Interrupt Handling: Exception handling, ARM processor exceptions and modes, vector table, exception priorities, link register offsets, interrupts, assigning interrupts, interrupt latency, IRQ and FIQ exceptions, basic interrupt stack design and implementation.

Firmware: Firmware and bootloader, ARM firmware suite, Red Hat redboot, Example: sandstone, sandstone directory layout, sandstone code structure.

Module-5

Caches: The Memory Hierarchy and Cache Memory, Caches and Memory Management Units: **Cache Architecture:** Basic Architecture of a Cache Memory, Basic Operation of a Cache Controller, The Relationship between Cache and Main Memory, Set Associativity, Write Buffers, Measuring Cache Efficiency, **Cache Policy:** Write Policy—Writeback or

Writethrough, Cache Line Replacement Policies, Allocation Policy on a Cache Miss. Coprocessor 15 and caches.

Laboratory Component:

Module – 1

1. Using Keil software, observe the various Registers, Dump, CPSR, with a simple Assembly Language Programs (ALP).

Module – 2

2. Develop and simulate ARM ALP for Data Transfer, Arithmetic and Logical operations (Demonstrate with the help of a suitable program).
3. Develop an ALP to multiply two 16-bit binary numbers.
4. Develop an ALP to find the sum of first 10 integer numbers.
5. Develop an ALP to find the largest/smallest number in an array of 32 numbers.
6. Develop an ALP to count the number of ones and zeros in two consecutive memory locations.

Module – 3

7. Simulate a program in C for ARM microcontroller using KEIL to sort the numbers in ascending/descending order using bubble sort.
8. Simulate a program in C for ARM microcontroller to find factorial of a number.
9. Simulate a program in C for ARM microcontroller to demonstrate case conversion of characters from upper to lowercase and lower to uppercase.

Module – 4 and 5

10. Demonstrate enabling and disabling of Interrupts in ARM.
11. Demonstrate the handling of divide by zero, Invalid Operation and Overflow exceptions in ARM.

List of Textbook and Reference book

Textbooks:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.

Reference Books:

1. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication, 2019.
2. Insider's Guide to the ARM7 based microcontrollers, Hitex Ltd.,1st edition, 2005

Course Outcomes	At the end of the course, the student will be able to: • Explain the ARM Architectural features and Instructions. • Develop programs using ARM instruction set for an ARM Microcontroller. • Explain C-Compiler Optimizations and portability issues in ARM Microcontroller. • Apply the concepts of Exceptions and Interrupt handling mechanisms in developing applications. • Demonstrate the role of Cache management and Firmware in Microcontrollers.

Internal Assessment Marks: 50 (CIE for theory component-25 Marks: 2 Tests, each of 15 marks and other assessments for 10 marks and CIE for Practical component-25 Marks: conduction of the experiment along with laboratory record for 15 Marks and test for 10 Marks).

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

Subject Code:	BCS402	TITLE: Microcontrollers						Faculty Name:				
List of Course Outcomes	Program Outcomes											Total
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	
CO-1	3	2	2	2	-	-	-	-	-	-	-	2	11
CO-2	3	2	2	2	-	-	-	-	-	-	-	2	11
CO-3	3	2	2	2	-	-	-	-	-	-	-	2	11
CO-4	2	2	2	2	-	-	-	-	-	-	-	2	10
CO-5	3	2	2	2	-	-	-	-	-	-	-	2	11
Total	**14**	**10**	**10**	**10**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10**	**54**

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

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

Subject Code:	BCS402	TITLE: Microcontrollers	Faculty Name:	
List of Course Outcomes	Program Specific Outcomes			
	PSO-1	PSO-2		Total
CO-1	-	-		-
CO-2	-	-		-
CO-3	-	-		-
CO-4	-	-		-
CO-5	-	-		-
Total	-	-		-