

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - DATA SCIENCE

### COURSE MODULE OF THE SUBJECT TAUGHT FOR THE SESSION 2025-26 (EVEN SEM)

#### Course Syllabi with CO's

Faculty Name: Mr. J N Karthik			Academic Year: 2025 – 2026				
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
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. Understand the fundamentals of ARM-based systems and basic architecture of CISC and RISC.</li> <li>2. Familiarize with ARM programming modules along with registers, CPSR and Flags.</li> <li>3. Develop ALP using various instructions to program the ARM controller.</li> <li>4. Understand the Exceptions and Interrupt handling mechanism in Microcontrollers.</li> <li>5. Discuss the ARM Firmware packages and Cache memory polices.</li> </ol>						
Topics Covered as per Syllabus							
<p style="text-align: center;"><b>Module-1</b></p> <p><b>ARM Embedded Systems:</b> The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.</p> <p><b>ARM Processor Fundamentals:</b> Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions.</p> <p><b>Module-2</b></p> <p><b>Introduction to the ARM Instruction Set:</b> Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants.</p> <p><b>Module-3</b></p> <p><b>C Compilers and Optimization:</b> Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing, Portability Issues.</p> <p><b>Module-4</b></p> <p><b>Exception and Interrupt Handling:</b> 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.</p> <p><b>Firmware:</b> Firmware and bootloader, ARM firmware suite, Red Hat redboot, Example: sandstone, sandstone directory layout, sandstone code structure.</p>							

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - DATA SCIENCE

### 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

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - DATA SCIENCE

<b>Course Outcomes</b>	<p>At the end of the course, the student will be able to:</p> <ul style="list-style-type: none"> <li>• <b>Explain</b> the ARM Architectural features and Instructions.</li> <li>• <b>Develop</b> programs using ARM instruction set for an ARM Microcontroller.</li> <li>• <b>Explain</b> C-Compiler Optimizations and portability issues in ARM Microcontroller.</li> <li>• <b>Apply</b> the concepts of Exceptions and Interrupt handling mechanisms in developing applications.</li> <li>• <b>Demonstrate</b> the role of Cache management and Firmware in Microcontrollers.</li> </ul>
------------------------	--

**Internal Assessment Marks:** 50 (CIE for theory component-25 Marks: 2 Tests/3 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)

<b>Course Code:</b>	<b>BCS402</b>	<b>TITLE: Microcontrollers</b>						<b>Faculty Name:</b>	Mr. J N Karthik				
<b>List of Course Outcomes</b>	<b>Program Outcomes</b>												
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	
<b>CO-1</b>	3	2	2	2	2	-	-	2	2	-	2		
<b>CO-2</b>	3	2	2	2	2	-	-	2	2	-	2		
<b>CO-3</b>	3	2	2	2	2	-	-	2	2	-	2		
<b>CO-4</b>	2	2	2	2	2	-	-	2	2	-	2		
<b>CO-5</b>	3	2	2	2	2	-	-	2	2	-	2		

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)

<b>Course Code</b>	<b>BCS402</b>	<b>Title: Microcontroller</b>	<b>Faculty name:</b>
<b>List of Course Outcomes</b>	<b>Program Specific Outcomes</b>		
	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	-	2
<b>CO2</b>	2	-	2
<b>CO3</b>	2	-	2
<b>CO4</b>	2	-	2
<b>CO5</b>	2	-	2

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