FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: BACHELOR OF TECHNOLOGY (Electronics and Communication)

Semester: VI

Course Code: 202060601

Course Title: Advance Microcontroller

Course Group: Professional Core Course

Course Objectives: This course will provide an opportunity to the students to learn ARM architecture, instruction set and programming. ARM is very popular for portable applications because of its high performance with low power consumption. Students will learn architecture, assembly language and Embedded C programming for ARM microcontroller in this course.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50/18	50/17	25/9	25/9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr. No	Contents	Hours
1	**THE ARM PROCESSOR FUNDAMENTALS AND INSTRUCTION SET:** ARM Register structure – Program Status register- Pipeline, Exception, Interrupts on vector table-core extension ARM Processor families. Data processing instructions-Branch Instructions-Load-store instructions, software Interrupts Program status register instructions, loading instructions-ARMv5E Extensions, conditional execution.	9
2	**THE THUMB INSTRUCTION SET AND ARM ARCHITECTURE:** THUMB register usage, ARM-THUMB Interworking-other Branch instruction, Data Processing instruction-single register Load-store instructions- multiple register load store instruction-stack instruction-Software Interrupt instructions – ARM Processor Cores - ARM assembly language programming - writing and optimizing ARM assembly code - Instruction schedules	9

3	ARCHITECTURAL SUPPORT FOR HIGH LEVEL LANGUAGE AND SYSTEM DEVELOPMENT: Conditional execution - looping constructs - Bit manipulation - Function and procedure - use of memory – ARM memory interface – AMBA bus architecture – Hardware system prototyping tools - the ARMulator - The JTAG BST architecture - The ARM Embedded trace - debug architecture	9
4	MEMORY HIERARCHY, EMBEDDED ARM CPU CORES AND ITS APPLICATIONS: Caches - Memory protection unit - Memory management unit - ARM CPU cores – The AMULET asynchronous ARM Processors. Embedded Operating Systems - Principle Components – Application case study – VLSI Ruby II Advanced communication processor – nuvoTon Cortex M0 (Nu-LB-NUC140) Microcontroller processor & its supporting tools	09
5	INTRODUCTION TO EMBEDDED C: C-looping structures – Register allocation – Function calls – Pointer aliasing – structure arrangement – bit fields – unaligned data and endianness – inline functions and inline assembly – portability issues. Embedded Systems programming in C – Binding & Running Embedded C program in Keil IDE – Dissecting the program - Building the hardware. Basic techniques for reading & writing from I/O port pins – switch bounce - LED Interfacing using Embedded C – Basics of SEOS.	09
		45

List of Practicals / Tutorials:

1	Introduction to ARM Assembly Language Programming with KEIL and Assembler Directives.
2	Write assembly language program for converting a nibbles into its equivalent ASCII number.
3	Write assembly language program to sort a given array into ascending order.
4	Write assembly language program to convert BCD to HEX HEX to BCD
5	Write assembly language program to add two arrays into THUMB mode programming.
6	Write an Assembly language program to ON and OFF the LED connected on MCB2140 module.
7	Write a C program to generate 1 Hz signal from port 0 and the same performed on MCB2140.
8	Write a C program to read potentiometer given on MCB2140 module through ADC0 which is available on LPC2148.
9	Write a C Program To Verify SPI Interface with Variable Clock Frequency And Data Transfer
10	Write a C program to verify UART serial communication and verify that same on MCB2140 and also with hyperterminal of a computer.
11	Student mini project based on ARM microprocessor

Reference Books:

1	Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wwight, Elsevier Publisher.
2	Arm System-on-chip Architecture, Steve Furber, 2nd Edition, Pearson.

3	ARM Assembly Language Programming & Architecture, Muhammad Ali Mazidi, 2nd Edition, 2016.
4	Michael J. Pont, "Embedded C", Pearson Education, 2007
5	David Seal, "ARM Architecture Reference Manual", Pearson Education, 2007.

Supplementary learning Material:	
1	NPTEL Video lecture on https://nptel.ac.in/courses/117106111/
2	Energia Software for Texas Tiva Board
3	Coursera Video Lectures

Pedagogy: The BOS members can incorporate following points as per the subject scheme. They can also include other relevant pedagogy methods.
- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying;
R	**U**	**A**	**N**	**E**	**C**	**N**: Analyzing; **E**: Evaluating; **C**: Creating
20	20	25	15	10	10	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Explain architecture and programming model of ARM microcontroller.	25
CO-2	Learn and analyze assembly language programs for ARM microcontroller	25
CO-3	Develop Embedded C language program for interfacing I/O devices with ARM microcontroller and use it.	25
CO-4	Exemplify memory management system of ARM and different versions of ARM.	25

Curriculum Revision:	
Version:	**2.0**
Drafted on (Month-Year):	June -2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025