GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3725409
Semester – II
Subject Name: ARM Microprocessor Architecture & System Design

Type of course: Core - III

Prerequisite: Fundamental knowledge of ARM7 processor architecture

Rationale:
Enhancement in the ARM processor architecture has resulted in to Cortex-M series architecture. This new architecture retains the best features from the 32-bit ARM architecture with the highly successful Thumb-2 instruction set design whilst adding several new capabilities such as low power consumption, Floating Point Unit, enhanced determinism and improved code density

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Background of ARM Processors and ARM Architecture:** Overview of ARM family Processor Evolution, Features supported in Cortex-M family processors: Cortex M0, M1, M3, M4, M7, Architecture details with advantages and applications	6
2	**CMSIS Standard and Cortex-M4 Programming:** Introduction to Cortex Microcontroller Software Interface standard (CMSIS), Organization and Standardization of CMSIS Core, CMSIS Core Structure, usage and benefits, CMSIS core register access, Intrinsic instruction, debug functions, Software development flow	12
3	**Memory System:** Memory System Features Overview, Memory Maps, Memory endianness, Memory Access Attributes, Default Memory Access Permissions, Bit-Band Operations, Unaligned Transfers, Exclusive Accesses	7
4	**Exceptions and Interrupts:** Exception Types, Interrupt Management, Priorities, Exception sequence, NVIC and SCB registers for exception control, Interrupt Masking, CMSIS functions for NVIC access	7

5	**Low Power and System Control Features:** Low Power Designs, Low power features, Instructions for low power operations: WFI, WFE.	**5**
6	**Floating Point Operations:** Single and double precision floating point numbers, Floating Point Unit (FPU) overview and registers, Lazy stacking, DSP applications using FPU	**5**
7	**Debug and Trace Features:** Requirements of Debug and Trace features, Debug Architecture and Interfaces, Debug modes, Data Watchpoint and Trace unit, Instrumentation Macrocell, Embedded Trace Macrocell	**5**

Reference Books:

1. The Definitive Guide to ARM Cortex-M3 and Cortex M4 Processor by Joseph Yiu, Newness Publication, 3rd Edition
2. The Designer's Guide to the Cortex-M Processor Family, A Tutorial Approach by Trevor Martin, Newness Publication, 1st Edition
3. The insider's Guide to the STM32 ARM based Microcontrollers by Trevor Martin, Hitex Publication, 2nd
Edition

Course Outcomes:

After learning the course the students should be able:

Sr. No.	CO statement	Marks % weightage
CO-1	Understanding Cortex – M4 architecture	20
CO-2	Develop programming skills for ArM / Cortex CPU.	25
CO-3	Learn the concepts of designing ARM / Cortex CPU based system	35
CO-4	Application development skill for implementing DSP algorithm with Floating Point Unit	20

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List of Experiments:

1. Introduction to Programming tool chain for Cortex CPU and study CMSIS library functions for Cortex CPU.
2. Write a program to drive GPIO using CMSIS core on STM32F429 Discovery Kit.
3. Write a program to verify Bit Band Memory operations.
4. Write a program to handle touch screen on the Graphic LCD of STM32F429 Discovery board.
5. Write a program to read accelerometer data and display in graphical form on LCD.
6. Write a program to handle an Exception handler using Nested Vector Interrupt Controller.
7. Write a program to implement a System Service Call using SVC instruction.
8. Write a program to handle timer with interrupt for generating PWM wave.
9. Configure Analog to Digital Convertor with Cortex processor to acquire analog signal and store the data in RAM locations.
10. Using Floating point unit, implement FIR filter.

Major Equipment:

i. STM32F429 Discovery Board
ii. Function Generator
iii. Oscilloscope
iv. Digital Multi-meter
v. DC Power Supply (0-30 V)

List of Open Source Software/learning website:

www.st.com,

www.keil.com