-GUJARAT TECHNOLOGICAL UNIVERSITY

Microcontrollers and Programmable Digital Signal Processors
SUBJECT CODE: 3715411
M.E. (Embedded Systems) SEM-I

Type of course: Core – II

Prerequisite: Microprocessor, Microcontroller, Digital Signal Processing

Rationale: This course is essential for understanding DSP processor architecture from leading company (Ex: TI, ARM, STM etc).

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**ARM Cortex-M4 processor:** Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces, Types of exceptions Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency, ARM Cortex M4 support for DSP applications	12	25%
2	**TM4C123 Microcontroller** Internal memory, General Purpose Input/Outputs (GPIOs), Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT, C Programming for Texas Tiva C Series Board	10	20%
3	**Programmable DSP (P-DSP) Processors:** Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, Programmable DSP applications for mobile handset, antenna array processing	10	20%
4	**VLIW architecture and TMS320C6000 series:** Introduction to TI DSP processor family, Architecture study, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations	7	20%
5	**Programming for TMS320C6000 series DSP:**	6	15%

	Code Composer Studio for application development for digital signal processing, On chip peripherals , Processor benchmarking, Programs to implement DSP algorithms FIR filtering, IIR filtering, Adaptive filtering on TMS320C6000		

Reference Books:

1. Dr. Mark Fisher, "ARM Cortex M4 Cookbook"
2. Joseph Yiu, "The definitive guide to ARM Cortex-M3 and M4 Processors", Elsevier, Third Edition
3. Sen M. Kuo, Woon-Seng S. Gan "Digital Signal Processors, Architecture, Implementations and Applications"
4. Alan Gatherer, Edgar Auslander, "Applications of programmable DSP s in mobile communication", Wiley publications
5. Venkatramani B. and Bhaskar M. "Digital Signal Processors: Architecture, Programming and Applications" , TMH , 2nd Edition
6. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication
7. Steve furber, "ARM System-on-Chip Architecture", Pearson Education
8. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley
9. Technical references and user manuals on www.arm.com, NXP Semiconductor www.nxp.com and Texas Instruments www.ti.com

Course Outcomes:

At the end of this course, students will be able to

- Compare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.
- Identify and characterize architecture of Programmable DSP Processors
- Develop small applications by utilizing the ARM processor core and DSP processor based platform.

List of Experiments:

This list is general guideline. List of experiments may vary from institute to institute depending on availability of resources at the institute/university)

1) ARM-cortex M4 GPIO Programming (Texas Tiva board)
2) ARM-cortex M4 Interrupt programming (Texas Tiva board)
3) ARM-cortex M4 Timer programming (Texas Tiva board)
4) ARM-cortex M4 ADC programming (Texas Tiva board)
5) Generation of PWN using ARM-cortex M4 processor (Texas Tiva board)
6) Implementation of FFT in TMS320C67x processor
7) DSP TMSC6748 board experiments like generate echo effect, generate flanging effect, Implement FIR filter, Implement IIR filter etc.
8) Implementation of adaptive filtering in TMS320C67x processor

Major Equipment:

1. Code Composer Studio
2. Texas Tiva C Series board (Example: TMS4C123GH6PM)
3. TMS320C6748™ Fixed- and Floating-Point DSP Board

List of Open Source Software/learning website:

- NPTEL Lectures
- Energia (Rapid prototype plateform for TI MCU launchpad)