GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (SIGNAL PROCESSING AND VLSI TECHNOLOGY) (26)

DIGITAL SIGNAL PROCESSORS: ARCHITECTURE AND PROGRAMMING

SUBJECT CODE: 3712608

SEMESTER: I

Type of course: Advanced Processor Architecture and Programming

Prerequisite: Students should have an understanding of Microcontroller architecture as well as basic C and assembly language programming skills and basic understanding of discrete time signals and systems

Rationale: Students of ME in Signal Processing must acquire fundamental concepts of Digital Signal Processing and implementation of various applications on Advanced Processor. Students also must understand architecture of advanced Digital Signal Processor and how to program it for signal processing applications.

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.	Topics	Teaching Hrs.	Module Weightage
1	**Programmable DSP Hardware:** • Processing Architectures (von Neumann, Harvard) • DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT) • IEEE standard for Fixed and Floating Point Computations • Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters) • On-Chip peripherals • DSP benchmarking	6	14%
2	**Structural and Architectural Considerations:** • Parallelism in DSP processing • Texas Instruments TMS320 Digital Signal Processor Families • Fixed Point TI DSP Processors:TMS320C1X and TMS320C2X Family • TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing) • Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields • TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices • Illustrative Examples for assembly codingation (EMIF)	22	52%
3	**VLIW Architecture:**	7	17%

	• Current DSP Architectures • GPUs as an alternative to DSP Processors • TMS320C6X Family, Addressing Modes • Replacement of MAC unit by ILP • Detailed study of ISA • Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming • Simple applications developments as an embedded environment		
4	**FPGA based DSP Systems:** • Limitations of P-DSPs • Requirements of Signal processing for Cognitive Radio (SDR) • FPGA based signal processing design-case study of a complete design of DSP processor	7	17%
Total		42	100 %

Reference Books:

1. M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
2. Fayez Gebali, "Algorithms and Parallel Computing",1stEdition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
4. Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007
7. Rulph Chassaing ,Donald Reay , Digital Signal Processing and Application with theTMS320C6713 and TMS320C6416 DSK, 2nd edition, wiley Publication.
8. B Venkataramani, M Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, 2nd edition, TMH, New Delhi
9. User guide - Texas Instrumentation

Course Outcome:

After successfully completion of this course, students should able to –

1. Write, Debug and simulate assembly as well as C code for Digital Signal Processor on Code Composer Studio environment.
2. Describe the architecture and basic operation of fixed-point and floating-point DSPs.
3. Explain the importance of on-chip Hardware modules of DSPs.
4. Develop and realize computationally efficient algorithms on the DSP platform (e.g. FFT, convolution- correlation etc.).
5. Optimize DSP code (e.g. software pipelining).
6. Describe recent application on DSP platform.

List of Experiments:

1. To study the architecture of DSP chips – TMS 320 6713 a 32-bit floating point processor
2. Introduction of Code Composer Studio.

3. To write and verify assembly language program using C67x processor for data transfer operation.
4. To write and verify assembly language program using C67x processor for arithmetic operation.
5. To write and verify assembly language program using C67x processor for logical operation
6. To write and verify assembly language program using C67x processor which calls assembly language program for various operation.
7. To write and verify 'C' language program using C67x processor for various operation.
8. To write and verify 'C' callable assembly language program using C67x processor for various operation.
9. To write and verify linear assembly language program using C67x processor for various operation.
10. To study the working of TMS 320C 6713 DSP development kit.
11. To write 'C' program using C67x processor for various operation and verify it on DSP Kit.

Major Equipments:

1. TMS 320C 6713 DSP development kit.

List of Open Source Software:

Code composer studio environment or equivalent,

Learning website:

www.nptel.ac.in, www.ti.com