GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Electronics & Communication (Communication System Engineering)

Course / Subject Code : ME01000351

Course / Subject Name : DSP Architecture

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	Signals and Systems, Digital Signal Processing
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.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Identify and formalize architectural level characterization of P-DSP hardware	U
02	Design, programming (assembly and C), and testing code using Code Composer Studio environment	C
03	Deploy DSP hardware for Control, Audio and Video Signal processing applications	A
04	Understand major areas and challenges in DSP based embedded systems	U
05	Optimize DSP code (e.g. software pipelining).	E

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of 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.	9	20
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 coding.	9	20
3.	**VLIW Architecture**: 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, On-chip peripherals, Simple applications developments as an embedded environment.	9	20
4.	**Multi-core DSPs**: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).	9	20
5.	**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.	9	20
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**20**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1 st Edition, PHI, 2006.
2. Fayez Gebali, "Algorithms and Parallel Computing",1st Edition, 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", 1 st Edition, CRCPress, 2010.
5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1 st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007
7. Rumph Chasseing, 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 Instruments

(b) Open source software and website:

1. www.ti.com
2 https://nptel.ac.in

Suggested Course Practical List: (30 Hours)

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.
12. Write a 'C' program using C67x processor to generate Harmonics of a Sinusoidal signal.
13. Write assembly language program using C67x processor to find convolution of two sequences. 14. Write a 'C' program using C67x processor to find convolution of two sequences.
15. Write a 'C' program using C67x processor to find correlation of two sequences.
16. Write a 'C' program using C67x processor to compute 8-point DFT.

List of Laboratory/Learning Resources Required:

TMS 320C 6713 DSP development kit

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