



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Applied Instrumentation

Subject Code : ME02067091

Subject Name : Advance VLSI Design

WEF Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite :	Digital Logic Design
Rationale :	This course introduces overview and fundamentals of VLSI design and provides the essential knowledge about the main themes so the students will be able to readily apply this knowledge in industry or research.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Understand the main elements of hierarchical VLSI design namely integrated circuit technology, approaches to system design, architectural issues, design implementation and layout Understanding Virtual Instrument concepts	UN
02	Able to apply VLSI design methodology for the design of application specific integrated circuits.	AP
03	Design the system with VLSI integration	CR

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme :

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



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Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Introduction to VLSI Design and Verilog: Conventional approach to digital design, VLSI design, ASIC design flow, Role of HDL, Verilog as an HDL, Levels of design description, Concurrency, Simulation and synthesis, Functional verification, System tasks, Programming language interface, module, Simulation and synthesis tools, Test benches.	3	7%
2	Language Constructs and Conventions in Verilog: Keywords, Identifiers, White space characters, Comments, Numbers, Strings, Logic values, Strengths, Data types, Scalars and vectors, Parameters, Memory, Operators, System tasks.	3	7%
3	Architecture of FPGA: Generic FPGA architecture, Architectural overview, Configuration, I/O capabilities, Program design flow, Device programming, Design implementation using FPGA, Simulation, Compilation, Floor planning and architecture design: floor planning methods, off-chip connections, High –level synthesis, Architecture testing.	4	9%
4	Gate Level Modelling: Basic gate primitives, Module structure, Tri state gates, Array of instances of primitives, Design of flip-flops with gate primitives, Delays, Strengths and contention resolution, Net types, Design of basic circuits.	4	9%
5	Modelling at Data Flow Level: Continuous assignment structures, Delays and continuous assignments, Assignment to vectors, Operators.	6	13%
6	Behavioural Modeling: Operations and assignments, Functional Bifurcation, Initial, always and wait constructs, Assignments with delays, Multiple always blocks, Design at behaviour level, Blocking and non-blocking assignments, Case statement, Simulation flow, If and if-else, assign-de assign, repeat, disable and force-release constructs, For, while and forever loops, Parallel blocks, Event.	6	13%
7	User Defined Primitives and FSM: User-defined primitives (UDP), Mealy and Moore finite state machine.	4	9%
8	Architecting Speed, Area and Power:	10	22%



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	High throughput, Low latency, Timings, Rolling Up the pipeline, Resource sharing, Impact of reset on area, Clock control, Input control, Reducing the voltage supply, Dual edge triggered flip-flops.		
9	Clock Domains: Crossing clock domains, Gated clocks in ASIC prototypes.	5	11%
	Total	45	100

Reference Book:

1. Design through Verilog HDL, Wiley student edition, T. R. Padmanabhan and B. Bala Tripura Sundari
2. Steven Kilts, Advanced FPGA Design, John Wiley & Sons, 2007
3. Clive Max Field, The Design Warriors Guide to FPGA, Elsevier, 2004
4. Verilog HDL by Samir Palniker.
5. Digital Design & Implementation with Field Programmable Devices by Zainalabedin Navabi.
6. Design recipes for FPGAs by Dr. Peter R. Wilson, Elsevier.

Suggested Course Practical List:

Simulation and synthesis of various combinational and sequential circuits in verilog HDL using Xilinx tool.

1. Implementation of PID controller in FPGA.
2. Design and optimization of arithmetic logic unit (ALU) for area, speed and power in FPGA.
3. Implementation of real time embedded system on FPGA.
4. Implementation of digital filters, transforms and algorithms in FPGA.
5. Implementation of simple processor and soft core on FPGA.
6. Implementation of a PS/2 keyboard reader on the FPGA and one other simple (open ended) design on the FPGA.
7. Implementation of a video capture and display system using the FPGA board, a camera and a VGA monitor.
8. Implementation of a SoC in a hardware software co- design fashion

List of Laboratory/Learning Resources Required:

- Xilinx
- Altera
- NTPEL

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