GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering Syllabus

Subject Code : 3726302

Subject Name : Principles of ASIC Design

WEF Academic Year :	2023 - 24
Semester :	2
Category of the Course :	Core

Prerequisite :	Basic knowledge of Digital Logic Design, FPGA, HDL, and Digital CMOS System.
Rationale :	This course provides a platform for students to impart knowledge on Design the Internal architectures of FPGA's , Programming ASIC design software and Low-Level Design Entry , Classify the types of ASIC and ASIC Library Design. Students work from design entry using HDL code to GDSII file generation of an ASIC.

Course Scheme :

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

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Introduction to ASIC :** Types of ASICs, Design flow, CMOS transistors, CMOS Design rules, Combinational Logic Cell, Sequential logic cell, Data path logic cell, Transistors as Resistors, Transistor Parasitic Capacitance, Logical effort, Library cell design, Library architecture.	10	20
2	**PROGRAMMABLE ASICS, LOGIC CELLS AND I/O CELLS :** Anti-fuse, static RAM, EPROM and EEPROM technology, PREP benchmarks, Actel ACT, Xilinx LCA, Altera FLEX, Altera MAX DC & AC inputs and outputs, Clock & Power inputs, Xilinx I/O blocks.	10	20
3	**PROGRAMMABLE ASIC INTERCONNECT AND DESIGN SOFTWARE :** Actel ACT, Xilinx LCA, Xilinx EPLD, Altera MAX 5000 and 7000, Altera MAX 9000, Altera FLEX, Design systems, Logic Synthesis, Half gate ASIC, Schematic entry, Low level design language, PLA tools, EDIF, CFI design representation.	10	20
4	**FPGA ARCHITECTURES, SIMULATION AND TESTING :** FPGA Architectures, SRAM-Based FPGAs, Permanently Programmed FPGAs, Chip I/O, Types of simulation, boundary scan test, Fault simulation, Automatic Test Pattern Generation, Introduction to JTAG	08	20

5	**PHYSICAL DESIGN OF ASIC :** System partition, FPGA partitioning, partitioning methods, floor planning , placement, physical design flow, global routing, detailed routing, special routing, circuit extraction, DRC.	08	20
	Total	**46**	**100**

Reference Book :

1. M. J. S. Smith, "Application - Specific Integrated Circuits ", Pearson Education, 2013.
2. Andrew Brown, "VLSI Circuits and Systems in Silicon", McGraw Hill, 2011.
3. S.D. Brown, R.J. Francis, J. Rox, Z.G. Uranesic, “Field Programmable Gate Arrays” Kluwer Academic Publishers, 2012.
4. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, 2000.
5. FPGA-Based System Design, Wayne Wolf, Published by Prentice Hall, 2004.
6. Jose E. France, YannisTsividis, " Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing ", Prentice Hall, 1994.
7. Vikram Arkalgud Chandrasetty “A Practical Guide for VLSI Designers: FPGA/ASIC design and implementation flows illustrated with examples”, create space, 2011.
8. Recent literature in Design of ASICs.

Course Outcome :

After Completion of the Course, Student will able to :

No.	Course Outcomes
01	Analyze the passive elements for ASIC design.
02	Analyze the characteristics of Programmable ASIC I/O cells.
03	Analyze the synthesis part on different logic structures.
04	Test the Integrated Circuit using various procedures.
05	Perform full custom ASIC design of digital blocks.
06	Analyze the physical design flow of ASIC.

Suggested Course Practical List :

Each student have to carry out practical’s involving analysis, design and testing of substantial hardware modules using any front end tools with some layout exercises using backend tools.

1. Design of MOD 10 Counter
2. Design of MAC Unit
3. Design of 8 bit Signed Booth Multiplier
4. Design of 4 tap FIR Filter
5. Design of Viterbi Decoder
6. FSM Synthesis

7. Explore Linux based tool for ASIC flow
8. Design any digital block using ASIC flow tool
9. Minor project

List of Laboratory/Learning Resources Required :

Tool for ASIC flow, Frond end VLSI tool, Layout tool, FPGA kits

List of Open Source Software/learning website :

1. www.esilicon.com
2. www.go.distance.ncsu.edu/digital-asic
3. www.asic-design.com
4. www.asic-world.com/
5. roi.seu.edu.cn/books/asics/asics.htm

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