

# **GUJARAT TECHNOLOGICAL UNIVERSITY**

**M.E. - Electronics & Communication Engineering  
(VLSI & Embedded Systems Design)**

## **Semester: I**

**Subject Name: Designing with FPGA's (Elective – I)**

**Subject Code: 715206**

### **Objective:**

The main objective of the course is to introduce digital design techniques using field programmable gate arrays (FPGAs). This will be followed by discussing FPGA architecture, digital design flow using FPGAs, and other technologies associated with field programmable gate arrays. The course study will involve lab projects to give students hands-on experience on designing digital systems on FPGA platforms.

### **Lecture:**

#### **UNIT I:**

Introduction to ASICs and FPGAs, Difference between ASICs, FPGAs and other programmable logic devices, Fundamentals in digital IC design, FPGA Programming Technologies, FPGA Logic Cell Structures, Basic FPGA technology (antifuse, RAM based etc)

#### **UNIT II:**

Basic FPGA Design Flow – Design Entry: VHDL, Time model (Elmore delay), Area model, Energy model, Synthesis, Clustering, Placement, Routing

#### **UNIT III:**

Optimization for FPGAs : Architecting Speed, Architecting Area, Architecting Power, Clock Domains, Synthesis, Optimization, Optimizing Physical Design, PCB issues

#### **UNIT IV:**

FPGA Programmable Interconnect and I/O Ports, FPGA Implementation of Combinational Circuits, FPGA Sequential Circuits, Timing Issues in FPGA Synchronous Circuits, Introduction to Verilog HDL and FPGA Design flow with using Verilog HDL, FPGA Arithmetic Circuits

#### **UNIT V:**

FPGAs in DSP Applications, FPGA High-level Design Techniques, Programming FPGAs in Electronic Systems, Latest Trends in Programmable ASIC and System Design

**Lab:**

The lab work will focus on relevant FPGA tools and will require students to use FPGA technology to implement arithmetic circuits and for DSP applications.

**Course Project:**

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

**Course Material:**

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

**Reference Books:**

1. Wayne Wolf, "FPGA-Based System Design," Prentice Hall, 2004
2. Steve Kilts, "Advanced FPGA Design," Wiley Inter-Science,
3. Xilinx User Manuals and Application Notes