Offered by **FPG IS1**
ICT Engineering

FPGA Programming with VHDL and Simulation

ECTS

5

Prerequisites
Knowledge about digital electronics and programming for two semesters.

Main purpose
The objective of this course is to provide students with a theoretical understanding of
- Circuit and System Design with VHDL
- Combinatorial VHDL, Sequential VHDL, Finite State Machines
- FPGA/PLD boards/devices
- Mapping of VHDL constructs to FPGA/PLDs

A further objective of the course is to provide the students with practical skills, enabling each student to
- Design circuits and systems in the VHDL design tool Xilinx ISE
- Validate circuit / system behavior through simulation, using Xilinx ISE built-in simulator or ModelSim
- Synthesize the circuits/systems onto the FPGA board NEXYS 2 (Spartan FPGA)

Competences
After this course, the student will be able to circuit design with VHDL, including use of the simulator.

Knowledge

Topics
- Circuit Design with VHDL

Code structure, Data Types, Operators and Attributes
o Concurrent code, sequential code, State machines, Signals and Variables
- System Design with VHDL

o Packages and Components, Functions and Procedures
o Additional system designs
- FPGA, Simple PLDs, Complex PLDs
- Xilinx ISE, Simulator, Synthesis

Teaching methods and study activities
The course will alter between theoretical interactive lectures and practical exercises in smaller teams of 2-3 students. Laboratory exercises designing, simulating and synthesizing circuits and systems. Examples could be:
- BCD to 7segment decoder
- Multiplexer display with components and with VHDL
- Synchronous state machines – ”Toggle-button” with debounce-elimination
- Stop watch as ”ad hoc design” and based on state machines
- Half adders, full adders, fast-carry adders
- Arithmetic circuit for: + - * and /
- Converter from binary to BCD

Resources

Circuit Design with VHDL, Volnei A. Pedroni, MIT Press, ISBN 0-262-16224-5. 2004.

Evaluation
To pass the course it is a condition that tuition activities selected as obligatory by the teacher have been carried

out within the set deadlines and approved. The student can choose either to be graded according to the Danish grading standards or to receive a pass/fail grade.

Grading criteria
Mark 12: Awarded to students who have shown excellent comprehension of the above-mentioned competences. A few minor errors and shortfalls are acceptable. Mark 02: Awarded to students for a just acceptable level of comprehension of the required competences.

Additional information
40 lessons with teacher/professor. It is mandatory to participate in each lesson and to do the homework. In case of illness we need documentation from a doctor - and only one day off will be accepted.

Responsible
Jesper Grode

Valid from
1.3.2012