NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech.in Electronics and Instrumentation Engineering
Semester:	V
Course Code:	3EI601ME24
Course Title:	Digital Design for Instrumentation
Course Type:	Departmental Elective-I
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. illustrate the basics of digital design and devices **(BL2)**
2. design combinational circuits using HDL **(BL4)**
3. design sequential circuits using HDL **(BL4)**
4. analyse asynchronous circuits **(BL4)**

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Introduction to design concepts** Introduction to digital design, significance of digital design over analog design, digital Hardware, design process, design of digital hardware, difference between FPGA and microcontroller-based designs	**04**
Unit- II	**Programmable logic devices** Difference between ASIC design and FPGA design, field programmable logic arrays (FPGA), applications of CPLDs and FPGAs, introduction to HDL programming	**05**
Unit- III	**Combinational circuit building blocks** Multiplexers, decoders, encoders, code converters, arithmetic comparison circuits, HDL programming for combinational circuits	**08**
Unit- IV	**Flip-flops, registers,counters** Basic latch and flip flop structures, design with JK flip-flop, registers, counters, reset synchronization, BCD counter, HDL programming for registers and counters	**09**
Unit- V	**Sequential circuits** Basic design steps of sequential circuits, state machine concept, design of finite state machines, Moore design, Mealy design, design of counter using sequential circuit approach, algorithmic state machine chart, serial adder example	**09**
Unit- VI	**Asynchronous sequential circuits** Analysis and synthesis of asynchronous circuits, state reduction, state assignment, hazards, the vending machine controller	**05**
Unit- VII	**Applications related to Instrumentation** Analog to digital converter interface, digital to analog interface, data acquisition, control algorithms, memory implementation, pulse width modulation generation, stepper motor speed control.	**05**

Self Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
This shall consist of at least 10 practicals based on the above syllabus.

Suggested Reading:

1. S. Brown, Z. vranesic, Fundamentals of digital logic design with VHDL
2. C. H. Roth, Fundamental of logic design, Jaico Publishing House
3. V. A. Pedroni, Circuit Design with VHDL, MIT press
4. D. L. Perry, VHDL: Programming by Example, Tata McGraw-Hill Publication
5. K. Skahill, VHDL for Programmable Logic, Pearson Education

Suggested List of Experiments (not restricted to the following):
(Only for Information)

1.	To verify truth table of basic logic gates.	**(02 Hrs)**
2.	To realize all basic gates with NAND gates only.	**(02 Hrs)**
3.	To construct binary half and full adder.	**(02 Hrs)**
4.	To construct the binary half and full subtractor.	**(02 Hrs)**
5.	To realize Binary-to-Gray and Gray-to-Binary code converter.	**(02 Hrs)**
6.	To design a 4-bit Magnitude Comparator and to verify the operation.	**(02 Hrs)**
7.	To observe the performance of Multiplexer.	**(02 Hrs)**
8.	To verify truth tables of various RS and D flip-flops.	**(02 Hrs)**
9.	To verify truth tables of various JK and T flip-flops.	**(02 Hrs)**
10.	Design of Binary Synchronous Counter as a count of 'N'.	**(02 Hrs)**
11.	To realize binary ripple counter.	**(02 Hrs)**
12.	To realize binary shift register.	**(02 Hrs)**

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2024 - 25 and onwards