ELEC 2225: Introduction to Digital Systems

2021 Winter Session	
Total Class Sessions: 25 **Class Sessions Per Week: 6** **Total Weeks: 4** **Class Session Length (Minutes): 145** **Credit Hours: 4**	**Instructor: Staff** **Classroom: TBA** **Office Hours: TBA** **Language: English**

Course Description:

This course provides an introduction to digital systems. Major topics include: number systems, logical and binary systems, AND-OR, NAND-NOR Logic, truth tables, Boolean algebra, the Karnaugh Maps, programmable logic device, sequential logic, latches, flip flops, synchronization, synchronous machine design, synchronous counters, moore machines, mearly machines, finite state machines with programmable logic, brainless microprocessor, microprocessor controller design, CPU architecture, microprocessor systems.

Learning Objectives:

Upon successfully completion of this course, students will be able to:

•Solve problems involving digital codes, operations, and number systems

•Describe, analyze, design, fabricate combinational and sequential, logic circuits

•Describe, explain, execute memory operations

•Apply computer mathematical and/or simulation tools to solve digital systems problems

•Conduct basic laboratory experiments involving design and construction of digital circuits and systems

•Choose the best design based on the criteria made on your own

•Describe the operation of an elementary microprocessor and create an instruction set for it

Course Materials:

Textbook:

Introduction to Logic Design, 3rd Edition, by Alan B. Marcovitz, McGraw- Hill, 2009.

*Lab Manual will be distributed in class

Course Format and Requirements:

The course format includes lecture, lab, and in-class discussion. The specific topics that will be covered in the classes are listed in the course syllabus. Students are expected to behave in a professional manner while in class. Behaviors that are distracting or that may otherwise impede the learning of other students will not be tolerated. Lectures may contain material that is not in the textbook. Such material may appear in homework and on exams. Additional information,

such as changes to the course schedule or due dates, may also be distributed in class. It is the student's responsibility to seek out any and all disseminated information in the event that he or she misses a scheduled class period. Attendance and promptness are expected. Note that only two unexcused absences will be permitted without penalty. Three or more unexplained absences will lower your final grade.

Course Assignments:

Homework Homework exercises should be done by the next class after they are assigned. It's important to finish all assigned homework because some of the questions on exams and quizzes will be based on homework exercises.
Quizzes In-class quizzes will always be at the beginning of class. These quizzes are closed book/notes, but you may use a calculator. Please make sure to show up to class on time so that you do not miss the quiz. There will be 3 quizzes in all and lowest one will be dropped.
Lab Lab for this class is the in-class practice period together in common class time. Students will be given in-class assignments to work on. To receive full credit for a lab, students must complete all of the assigned problems, and finish all required submission on time.
Midterm Exams There will be two in-class midterm exams in this course. The midterm exam will be based on concepts covered in class. It will be in-class, close-book and non-cumulative. The in-class midterm will always take the first half of the lecture time on that day.
Final Exam The final will be cumulative and close-book. Note that the final will not be taken during the normal class times. Exact time and location for final will be announced later.

Course Assessment:

Quizzes	10%
Homework	10%
Lab	15%
Midterm Exams 1	20%
Midterm Exams 2	20%
Final Exam	25%
Total	**100%**

Grading Scale (percentage):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
98-100	**93-97**	**90-92**	**88-89**	**83-87**	**80-82**	**78-79**	**73-77**	**70-72**	**68-69**	**63-67**	**60-62**	**<60**

Course Format and Requirements:

Students are expected to attend all lectures. Each lecture will build on the knowledge acquired in the previous one and, if you miss a class, you are responsible for getting the lecture notes from your classmates. Please do not use electronic devices such as phones, iPads, computers, etc. during the lectures.

Academic Integrity:

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.

Students are expected to adhere to the standards of academic honesty and integrity that are described in the Chengdu University of Technology's *Academic Conduct Code.* Any work suspected of violating the standards of the *Academic Conduct Code* will be reported to the Dean's Office. Penalties for violating the *Academic Conduct Code* may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the *Academic Conduct Code*.

Special Needs or Assistance:

Please contact the Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.

Course Schedule:

Class 1:
Course Overview;
Go through syllabus
Binary numbering;
Binary prefixes;

Class 2:
Binary arithmetic
Conversion between decimal and binary numbers, octal and binary number;
Decimal and octal numbers;
Binary to octal conversion;

Class 3:
Binary to hexadecimal conversion;
Complements
Addition and subtraction in binary;

Binary Codes (BCD), ASCII;

Class 4:
Quiz 1
Binary Storage;
Representation of Boolean functions
Elementary logic gates;
Binary Logic, AND, OR and NOT;

Class 5:
Quartus Introduction;
Circuit to Symbolic;
Circuit to Truth Table;
Symbolic to Circuit

Class 6:
Quiz 2
Boolean algebra;
Theorems of Boolean algebra, properties of operations, Boolean functions
Boolean reduction: Reduce logic, minimize the number of literals;
DeMorgan's Law;

Class 7:
Multi-input gates;
Canonical POS form;
Timing diagrams
Gate Level Minimization;

Class 8:
Midterm Exam 1

Class 9:
Karnaugh Maps, 3 variable
Karnaugh Maps, 4 and 5 variable
Multiple output functions
'Don't care's

Class 10:
SOP and POS in Karnaugh maps
NAND implementation of AND and OR gates,

Multilevel combinational logic circuits and implementation: NAND gates, NOR gates

Class 11:
Quiz 3
Possible 2-level implementations examples (sum of products, product of sums)
Exclusive OR functions and implementations, properties of XOR functions (MID)
Combinational Logic Analysis;

Class 12:
Adders;
the half adder, the full adder and ripple adder, carry look –ahead adder;
2's complement adder/subtractor;

Class 13:
Binary multiplier;
Comparator
Decoders;

Class 14:
Quiz 4
Multiplexers
Basic memory elements
SR latch and flip flop

Class 15:
Register, parallel load register, N-bit shift register
Universal shift register, Ripple counters, synchronous counters, K-map design
Tri-State Logic;

Class 16:
RAM;
Transition Lists
Sequential Design: Synchronous and asynchronous sequential circuits

Class 17:
Midterm Exam 2

Class 18:
Sequential Design: D flip-flop, JK flip-flop, T flip-flop

Class 19:
Sequential Design: Characteristic equation, asynchronous input, state equations to characterize sequential circuits, circuit diagram state equations, sequential circuit HDL examples

Class 20:
Quiz 5
Digital Integrated Circuits CMOS technology, MOSFET

Class 21:
N-channel device
P-channel device

Class 22:
CMOS inverter, CMOS NAND gate, CMOS NOR gate, CMOS AND gate
Timing;

Class 23:
Quiz 6
FSM analysis, advanced VHDL
Turing machines, asynchronous design, hazard avoidance, flow tables, stable states

Class 24:
Encodings: Gray, Reed Solomon, RAIDs, parity, Hamming, error correcting codes
Testing logic circuits;

Class 25:
Path analysis, built-in self-test, signature generation
Warp-up
Review for final

Final Exam (Cumulative): TBA