Date Prepared: January 15, 2022

Prepared by: Elias Kougianos

Instructor: Elias Kougianos
Office: F140
Office Hours: TR 2:30—4:00 PM in F140
Phone: 940-891-6708
Email: Elias.Kougianos@unt.edu

Course web site: http://canvas.unt.edu
Time: TR 11:30AM—12:50 PM
Meeting Place: NTDP B190

TA: TBD
Office: TBD
Office Hours: TBD
Email: TBD

Course Number, Title, Credit Hours: EENG2710.003 Digital Logic Design, 3 Credit Hours

Course Description:

History and overview; switching theory; combinational logic circuits; modular design of combinational circuits; memory elements; sequential logic circuits; digital system design; fault models and testing.

Prerequisite(s): Engineering or engineering technology majors.

Corequisite(s): EENG 2711 (Digital Logic Lab, which must be completed with a grade of C or better) for Biomedical Engineering (Bioinstrumentation track), Computer Engineering, and Electrical Engineering majors.

Course Topics:

- Number Systems and Digital Logic Gates
- Boolean Algebra, Switching Functions and Canonical Forms
- Combinational Circuit Minimization, Analysis, and Synthesis
- Sequential circuits elements and sequential logic circuits
- Modular Sequential Logic- Counters and shift registers
- Analysis and Design of synchronous sequential circuits
**Textbook(s) and/or required material:**


Additional material, as required, will be provided on Canvas.

**Course Objectives:**

The main objectives of the course are to facilitate the students to achieve the highest levels in the Bloom's 6-level Learning Taxonomy so that they, at the end of the course, will be able to:

1. **Know** what digital systems are, how they differ from analog systems and why it is advantageous to use the digital systems in many applications.
2. **Comprehend** different number systems including the binary system and Boolean algebraic principles.
3. **Apply** Boolean algebra to switching logic design and simplification.
4. **Analyze** a given digital system and decompose it into logical blocks involving both combinational and sequential circuit elements.
5. **Synthesize** a given system starting with problem requirements, identifying and designing the building blocks, and then integrating these blocks into a complete system.
6. **Validate** the system functionality and evaluate the relative merits of different designs.

**Grading:**

- Homework: 30%
- Exam 1: 20%
- Exam 2: 20%
- Final: 30%

Grading scale (based on total course points):

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90% - 100%</td>
<td>A</td>
</tr>
<tr>
<td>80% - 89.99%</td>
<td>B</td>
</tr>
<tr>
<td>70% - 79.99%</td>
<td>C</td>
</tr>
<tr>
<td>60% - 69.99%</td>
<td>D</td>
</tr>
<tr>
<td>00% - 59.99%</td>
<td>F</td>
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</tbody>
</table>

**NOTES:**
The exam schedule is as follows:
- Test 1 is on Thursday February 24th, (Week 6) in NTDP B190
- Test 2 is on Thursday April 14th (Week 12) in NTDP B190
- The final exam will take place on TUESDAY May 10th 10:30AM – 12:30PM in NTDP B190
* Students with preapproved ODA arrangements will take all tests (including the final) at the ODA Test Center
During each test (including the final exam) you can consult a printout of the Canvas slides and any other pre-approved handouts (they will be announced prior to the tests). No notes, textbooks or other material. During tests the use of electronic devices such as cell phones, smart phones, smart watches, pagers, photographic devices and/or other electronic or communication devices, with the exception of calculators, is strictly prohibited. Such devices must be turned off during the tests. You may also be asked to leave you backpacks by the classroom door.

**Missed Exams:**

You will be allowed to make up a missed exam only if you have a documented university excused absence and received prior approval. For more details visit the UNT Dean of Students’ web page: [https://deanofstudents.unt.edu/resources](https://deanofstudents.unt.edu/resources)

**Assignments:**

Homework submission: Homework must be submitted electronically via Canvas. **No hand-delivered homework will be accepted.**

- **If you have access to a printer:** print out the homework and write the solutions in the space provided. Insert additional pages if needed but please make sure they clearly indicate which problem they belong to. Assemble all sheets, number them sequentially, scan them into a **single** pdf file using a scanner or your cell phone and submit the file via Canvas before the deadline.

- **If you do not have access to a printer:** Write out the answers to the problems by hand, one problem per page. Make sure you clearly label which problem solution the sheet belongs to. Assemble all sheets, number them sequentially, scan them into a **single** pdf file using a scanner or your cell phone and submit the file via Canvas before the deadline.

- Alternatively, you can write directly on the pdf file using a tablet or laptop with a stylus.

Homework must be submitted on the due date before the deadline. Late homework will be accepted but will be penalized as follows:

- 24 hours late: 5% penalty
- 24-48 hours late: 10% penalty

The precise time of submission is determined by Canvas and the appropriate penalty will be automatically deducted by the system. **NO EXCEPTIONS.** That means that if you are even a second late, the system will mark you as late. **Conclusion: submit your work well before the deadline.**

The lowest-grade homework will be dropped from the final grade calculation.

**Grade-related policies:**

**Turnaround Time**

I aim to return graded work to you within one week of the due date. When this is not possible, I will send an announcement to the class.
Grade Disputes
You are required to wait 24 hours before contacting me to dispute a grade. Within that time, I expect that you will review the assignment details and reflect on the quality of the work you turned in. **You should then contact the grader and discuss the issue.** If you are not satisfied with the grader's response and you would still like to meet with me, email me to set up a meeting (I cannot discuss grade disputes over email). **In all email communications you should use your official UNT email account.** You should come to our scheduled meeting with specific examples that demonstrate that you earned a higher grade than you received. If you miss your scheduled meeting, you forfeit your right to a grade dispute. If you do not contact me to schedule a meeting within seven days of receiving your grade, you also forfeit your right to a grade dispute.

Extra Credit
There are no extra credit opportunities in this course.

**Academic Dishonesty:**

Cheating will not be tolerated. Anyone found guilty of cheating on a test or assignment will be awarded an F grade for the course. Discussions of problems and assignment with your classmates is welcome and encouraged, however, sharing of solutions is not. If you need help, you should ask the instructor. Cheating includes, but is not limited to, all forms of plagiarism and misrepresentation. For your rights and responsibilities please refer to [http://www.unt.edu/csrr](http://www.unt.edu/csrr)

**Disabilities Accommodation:**

The University of North Texas complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. The University of North Texas provides academic adjustments and auxiliary aids to individuals with disabilities, as defined under the law. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring accommodation, please see the instructor and/or contact the Office of Disability Access at 940-565-4323 **during the first week of class.** Information and requests for supporting letters can be obtained from: [https://disability.unt.edu/](https://disability.unt.edu/)

**Additional Policies and Procedures:**

1. Attendance is mandatory. 3 unexcused absences will result in automatic course drop. If you know ahead of time that you will miss a class, contact me via email in advance. Attendance will be spot checked. For COVID-19 cases, see the statement below.
2. State common law and federal copyright laws protect my lectures. They are my own original expression. Whereas you are authorized to take notes in class thereby creating a derivative work from my lecture, the authorization extends only to making one set of notes for your own personal use and no other use. You are not authorized to record my lectures, to provide your notes to anyone else or to make any commercial use of them without expressed prior permission from me. Synchronous (live) sessions in this course will be recorded for students enrolled in this class section to refer to throughout the semester. Class recordings are the intellectual property of the university or instructor and are reserved for use only by students in this class and only for educational purposes. Students may not post or otherwise share the recordings outside the class,
or outside the Canvas Learning Management System, in any form. Failing to follow this restriction is a violation of the UNT Code of Student Conduct and could lead to disciplinary action.

3. This syllabus is subject to change at any time during the semester with changes to be announced in class.

4. An I (incomplete) grade is given only for extenuating circumstances and in accordance with University and Departmental Policies.

5. To comply with FERPA policies, I will communicate via email (email me at Elias.Kougianos@unt.edu) but I will only respond to UNT email accounts.

6. Each student should retain graded lecture notes, pop quizzes, homework, tests, software-generated files, and laboratory reports to document errors in recorded grades.

7. Challenges to the course grade must be presented within 60 days of receipt of grade notices mailed by the university. This will ensure that instructor’s records are still available to allow a review of the assigned grade. You should first discuss your complaint with the instructor. If you wish to carry it further, contact the Program Coordinator by calling (940) 891-6872. To further pursue your complaint, contact the Department Chair, but ONLY after first discussing your concern with the previous two individuals.

8. The Student Perceptions of Teaching (SPOT) is a requirement for all organized classes at UNT. This short survey will be made available to you at the end of the semester, providing you a chance to comment on how this class is taught. I am very interested in the feedback I get from students, as I work to continually improve my teaching. I consider SPOT to be an important part of your participation in this class.

9. Student behavior that interferes with an instructor’s ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. Visit UNT’s Code of Student Conduct (https://deanofstudents.unt.edu/conduct) to learn more.

**COVID-19 Impact on Attendance**

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to a related issue regarding COVID-19. It is important that you communicate with me prior to being absent so I may make a decision about accommodating your request to be excused from class.

If you are experiencing any symptoms of COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Hotline at 844-366-5892 or COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

**Reading Requirements:**

The students are required to come prepared to every class with the material discussed in the previous class.
**Course Outline and Tentative Schedule:**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>TOPIC</th>
<th>READING ASSIGNMENT</th>
<th>LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (1/18)</td>
<td>Course Introduction – Number Systems and Conversion – Binary Arithmetic</td>
<td>1.1 – 1.3</td>
<td>NO LAB</td>
</tr>
<tr>
<td>2 (1/24)</td>
<td>Negative Numbers – Binary Codes – Boolean Algebra</td>
<td>1.4 – 1.5, 2.1 – 2.5</td>
<td>1A: Number Systems (recitation)</td>
</tr>
<tr>
<td>3 (1/31)</td>
<td>Laws of Boolean Algebra – SOP &amp; POS Forms &amp; Simplification</td>
<td>2.6 – 2.8, 3.1 – 3.5</td>
<td>1B:  Boolean Algebra (recitation)</td>
</tr>
<tr>
<td>4 (2/7)</td>
<td>Minterms/Maxterms &amp; Applications of Boolean Algebra – Truth Tables and Incomplete Functions – Introduction to Karnaugh Maps</td>
<td>4.1 – 4.7, 5.1 – 5.3</td>
<td>2:  Introduction to Logic Simulation (software)</td>
</tr>
<tr>
<td>6 (2/21)</td>
<td>Review for Test 1 – Test 1</td>
<td></td>
<td>4: Introduction to Hardware Implementation (hardware)</td>
</tr>
<tr>
<td>7 (2/18)</td>
<td>Multi-Level Gate Circuits – NAND and NOR Gates</td>
<td>7.1 – 7.7</td>
<td>5: NAND/NOR Equivalent Circuits (software)</td>
</tr>
<tr>
<td>8 (3/7)</td>
<td>Combinational Circuit Design, Gate Delays, Timing Diagrams, and Hazards</td>
<td>8.1 – 8.4</td>
<td>6: Hardware Implementation of NAND/NOR (hardware)</td>
</tr>
<tr>
<td>9 (3/21)</td>
<td>Multiplexers, Buffers, Decoders, Encoders, and ROMs</td>
<td>9.1 – 9.5</td>
<td>7: Decoders (software)</td>
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<tr>
<td>3/14-3/18</td>
<td>SPRING BREAK</td>
<td></td>
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<tr>
<td>10 (3/28)</td>
<td>Latches and Flip-Flops – Registers and Counters (1)</td>
<td>11.1 – 11.10, 12.1 – 12.3</td>
<td>8: Multiplexers (software)</td>
</tr>
<tr>
<td>11 (4/4)</td>
<td>Registers and Counters (2) – Analysis of Clocked Sequential Circuits</td>
<td>12.4 – 12.6, 13.1 – 13.4</td>
<td>9: D flip-flops, shift registers (software)</td>
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<tr>
<td>12 (4/11)</td>
<td>Review for Test 2 – Test 2</td>
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<td>MAKE-UP LAB</td>
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<tr>
<td>13 (4/18)</td>
<td>Derivation of State Graphs and Tables – Reduction of State Table State Assignment (1)</td>
<td>14.1 – 14.6, 15.1 – 15.5</td>
<td>10: Simple Sequential Circuits (software)</td>
</tr>
<tr>
<td>14 (4/25)</td>
<td>Reduction of State Table State Assignment (2) – Sequential Circuit Design</td>
<td>15.6 – 15.9, 16.1 – 16.3</td>
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<tr>
<td>15 (5/2)</td>
<td>Pre-finals week - Review</td>
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<tr>
<td>5/10</td>
<td>Tuesday 5/10 – FINAL EXAM</td>
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<td>10:30AM-12:30PM in NTDP B190</td>
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Course Learning Outcomes (CLOs)

Course Learning Outcomes (CLOs), that is, the areas for student learning in this course are:

[CLO-1] Digital and Analog Systems: Basic Concepts and Historical Perspective
[CLO-2] Number Systems and Digital Logic Gates
[CLO-3] Boolean Algebra, Switching Functions and Canonical Forms
[CLO-5] Sequential circuit elements and sequential logic circuits
[CLO-6] Modular Sequential Logic – Counters and shift registers
[CLO-7] Analysis and Design of synchronous sequential circuits

Relationship between the Course Learning Outcomes and Program/ABET Outcomes

The course learning outcomes map onto the program and ABET outcomes as depicted in the table below.

<table>
<thead>
<tr>
<th>CLO</th>
<th>Student/ABET Criterion 3 Outcomes</th>
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<tbody>
<tr>
<td>1</td>
<td>X</td>
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<tr>
<td>2</td>
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