Course Outline (F2024)

COE328: Digital Systems

Instructor(s)	Dr. Vadim Geurkov [Coordinator] Office: ENG430 Phone: (416) 979-5000 x 556088 Email: vgeurkov@torontomu.ca Office Hours: Thursday, 4 pm - 5 pm Dr. Reza Sedaghat Office: ENG431 Phone: (416) 979-5000 x 556083 Email: rsedagha@torontomu.ca Office Hours: TBA Arghavan Asad Office: EPH432 Phone: TBA Email: arghavan.asad@torontomu.ca Office Hours: Thursdays 6:00pm-7:00pm
Calendar Description	This course covers the basics digital logic circuits and emphasizes on good understanding of basic concepts in modern digital system design. The course introduces computer aided design (CAD) tools including the use of hardware description language (HDL) for design entry. It also discusses the use of the latest available implementation technologies including CPLDs and FPGAs for mapping the design to modern technology. This course covers basic logic circuits, Boolean algebra, and implementation technology (from transistor to CPLDs and FPGAs). It also introduces logic functions optimization and implementation, number representation and arithmetic circuits, combinational circuits, synchronous and asynchronous sequential circuits as well as introduction to control unit data path and CPU operations. The Laboratory work requires the uses of CAD tools to design and simulate basic digital circuits. Implementation and testing of simple digital systems in LSI and CPLD will also be considered. (Formerly ELE 328.)
Prerequisites	CPS 188, ELE 202, MTH 240
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. Brown, S. and Vranesic, Z. Fundamentals of Digital Logic with VHDL Design, Third Edition, McGraw-Hill, 2009. 2. Hayes, J. Introduction to Digital Logic Design, Addison Wesley, 1993. (Library call number TK7868.L6H29 1993). 3. Course materials (including laboratory manual): Available through the course web page: https://www.ecb.torontomu.ca/~courses/coe328/
Reference Text(s):	1. Wakerly, J. Digital Design: Principles and Practices, Prentice Hall, 2003. (Library call number TK7874.65.W34 2000).

	2. Dewey, A. Analysis and Design of Digital Systems with VHDL, PWS PublishingCompany, 1997. (Library call number TK7868D5D47 1997).
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1. The theoretical and technical knowledge of design methodology from the lecture will be applied in the labs using design tools (Altera Quartus II, Altera FPGA boards) for analysis, simulation, visualization, synthesis, and design. Modern instrumentation such as logic analyzer, oscilloscope, etc. will be utilized to collect and validate the digital data. Learning various mathematical models and design methods for digital systems, such as Boolean algebra and optimization design strategies, gives the student the ability to solve principle engineering problems Selects and uses an appropriate method for problem definition. Describes differences between methods, performs a specified method in hypothetical design situation. (**4a**) 2. Learning various mathematical models and design methods for digital systems, such as Boolean algebra and optimization design strategies, gives the student the ability to solve principle engineering problems Selects and uses an appropriate method for problem definition. Describes differences between methods, performs a specified method in hypothetical design situation. (**4b**) 3. The student has to submit a report in Lab 7. S/He must read and appropriately responds to technical and non-technical instructions. (**7a**) **NOTE:** *Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*
Course Organization	4.0 hours of lecture per week for 13 weeks 3.0 hours of lab per week for 12 weeks 0.0 hours of tutorial per week for 12 weeks
Teaching Assistants	TBA
Course Evaluation	

Lab Work	30 %
Midterm Exam	35 %
Final Exam	35 %
TOTAL:	100 %

Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both **"Theory and Laboratory"** components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the **"Course Evaluation"** section above for details on the Theory and Laboratory components (if applicable).

Examinations	Midterm exam, Week 7, two hours, problems, closed book (covers Weeks 1-6). Final exam, during exam period, three hours, closed-book (covers Weeks 8-13).
Other Evaluation Information	None
Other	None

Course Content

Week	Hours	Chapters / Section	Topic, description
1	1		INTRODUCTION TO COE328
2	4		INTRODUCTION TO LOGIC CIRCUITS (Chapter 2 Sections 2.1 to 2.10)
3	4		IMPLEMENTATION TECHNOLOGY (Chapter 3 Sections 3.1 to 3.10)
4	4		OPTIMIZATION OF COMBINATIONAL LOGIC (Chapter 4 Sections 4.2 to 4.12)
5	4		NUMBER REPRESENTATION AND ARITHMETIC CIRCUITS (Chapter 5 Sections 5.1 to 5.8)
6	4		COMBINATIONAL CIRCUIT BUILDING BLOCKS (Chapter 6 Sections 6.1 to 6.6)
7-8	8		INTRODUCTION TO SEQUENTIAL CIRCUITS (Chapter 7 Sections 7.1 to 7.13)
9-10	8		SYNCHRONOUS SEQUENTIAL CIRCUITS (Chapter 8 Sections 8.1 to 8.9)
11	4		REGISTER-LEVEL DESIGN (Chapter 8 Sections 8.1 to 8.6)

12	4		SYSTEM ARCHITECTURE (Chapter 9 Sections 9.1 to 9.4)
13	6		ASYNCHRONOUS SEQUENTIAL CIRCUITS (Chapter 9 Sections 9.1 to 9.6)

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
2-3	ENG306/307	Introduction to CAD Tools
4	ENG306/307	Functional Implementation and Minimization
5-6	ENG306/307	Adder and Subtractor Unit
7-8	ENG306/307	Combinational Circuits and Storage Elements
9-10	ENG306/307	Sequential Circuits: Implementing an Eight State Machine
11-13	ENG306/307	Design of a Processor Module

University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on the Senate website

Refer to the Departmental FAQ page for furhter information on common questions.

Important Resources Available at Toronto Metropolitan University

- The Library provides research workshops and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the Library's virtual research help service to speak with a librarian.

- Student Life and Learning Support offers group-based and individual help with writing, math, study skills, and transition support, as well as resources and checklists to support students as online learners.

- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: **Academic Consideration Request (ACR)** to submit this request.

  For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration.](#)

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown Browser and Monitor, using D2L Brightspace,](#) joining online meetings or lectures, and collaborating with the Google Suite.

- Information on Copyright for [Faculty](#) and [students](#).

Accessibility

- Similar to an [accessibility statement,](#) use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration and how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.