

Syllabus for Reconfigurable System Design Fall 2026

Course Information

Course Number: CMPE 691

Description: This course will cover digital systems concepts and design. A hardware description language (HDL), specifically SystemVerilog, will be used to model and synthesize digital blocks and systems, and to broadly explore digital system design. Parallel, iterative, and pipelined design alternatives for common digital compute blocks will be explored, as well as their integration into compute systems. Timing and performance analysis will be covered. Both fundamental concepts and practical designs with multi-clock domain systems will be taught, including usage of PLL and DLLs as well as synchronization and communication across multiple clock domains. Integration of custom designs with general purpose processors will be taught with the use of SoC FPGAs and/or soft-processors implemented in FPGAs.

Prerequisite Knowledge: Students are expected to have basic knowledge of and experience with circuit design, HDLs, digital design, and C programming.

Instructor: Dr. Ryan Robucci Office Hours: After Class and By Appointment

Course Texts

- Patrick R. Schaumont, A Practical Introduction to Hardware/Software Codesign 2nd Edition, Springer (ISBN:978-1461437369)
- Additional Readings will be provided on the course website

Grading

The planned distribution of weights for categories including exams, homeworks, and projects is as follows:

- Midterm 1 15%
- Midterm 2 25%

- Final 30%
- Assignments 35%

The categories and weights are subject to change by advance written notice which will be provided by email.

No grades of incomplete will be given for the course, except as required by university policy for truly exceptional circumstances.

Students are encouraged to participate in class.

Topic Plan

- Digital Design
 - Digital (and Analog) Systems and Representations
 - Verilog, an Event Driven Language to Model Digital Systems
 - Verilog: Metalogic Full and Parallel Case
 - Verilog Modules and Testbenches
 - Datapath 1 Building Blocks of Digital Systems
 - Datapath 2
 - Data Flow Modeling
 - Data Flow Graph Transformations, Throughput, Critical Path, and Clock Frequency
 - FSMD
 - Advanced FSM Coding, Unique, Priority
 - RAM, Busses Interfaces and Handshaking
- Computing with Integers
 - FGPAs and Digital ASIC
 - Computing with Integers Part I
 - Computing with Integers Part II
 - Iterative Implementations of Elementary Arithmetic Functions
 - Implementation of Elementary Functions
 - CORDIC
- Clocks and Communication
 - Metastability
 - Managing Metastability
 - Timing Analysis
 - Multi-clock Design
 - DLL, and PLL, Verilog Multi-clock design
 - Communications and Clock Management

Student Honor Code

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication,

plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Directory.

Accessibility and Disability Accommodations, Guidance and Resources

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: 410-455-2459

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination

UMBC Policy in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at ecr@umbc.edu or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the Online Reporting/Referral Form. Please note that, if you report anonymously, the University's ability to respond will be limited.

Notice that Faculty and Teaching Assistants are Mandated Reporters with Mandatory Reporting Obligations

All faculty members and teaching assistants are considered Mandated Reporters, per UMBC's Interim Policy on Sex Discrimination, Sex-Based Harassment, and Sexual Misconduct. Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received.

While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their rights, resources, and support. While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of Confidential Resources available to support you:

Retriever Integrated Health (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.

Center for Counseling and Well-Being (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) Online Appointment Request Form

Pastoral Counseling via The Gathering Space for Spiritual Well-Being: 410-455-6795; i3b@umbc.edu; Monday – Friday 8:00 a.m. – 10:00 p.m.

Women, Gender, and Equity Center (open to students of all genders): 410-455-2714; womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.

Other Resources

Shady Grove Student Resources, Maryland Resources, National Resources.

Child Abuse and Neglect

Please note that Maryland law and UMBC policy require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social

Services and / or the police even if the person who experienced the abuse or neglect is now over 18.

Pregnant and Parenting Students

UMBC's Interim Policy on Sex Discrimination, Sex-Based Harassment, and Sexual Misconduct expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University's Office of Equity and Civil Rights. Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the Office of Student Disability Services.

Religious Observances & Accommodations

UMBC Policy provides that students should not be penalized because of observances of their religious beliefs, and that students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences or requested modifications for religious observances in advance, and as early as possible. For questions or guidance regarding religious observances and accommodations, please contact the Office of Equity and Civil Rights at ecr@umbc.edu.

Hate, Bias, Discrimination and Harassment

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement.

Consistent with these principles, UMBC Policy prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate, or bias based upon a protected status or who have such matters reported to

them should use the online reporting/referral form to report discrimination, hate, or bias incidents. You may report incidents that happen to you anonymously . Please note that, if you report anonymously, the University's ability to respond may be limited.