2020

Discrete Systems Modeling

North Carolina Agricultural and Technical State University

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

COURSE SYLLABUS

College Name: College of Engineering
Department Name: Department of Electrical and Computer Engineering
Course Name: Discrete Systems Modeling

COURSE INFORMATION

- Course Number/Section: ECEN 227
- Term:
- Semester Credit Hours: 3
- Times and Days:
- Class Location:

INSTRUCTOR CONTACT INFORMATION

- Instructor:
- Office Location:
- Office Phone:
- Email Address:

Faculty must notify students of the approximate time and method they can expect to receive an answer to all communications (e.g., email, phone, course messages). Excluding holidays, the response should be provided within 48 hours.

If there's a graduate teaching assistant assigned to work with this course, please include their names also.

STUDENT HOURS

These are times students may visit the professor without an appointment to request the assistance they need.

NOTE: Students are responsible for reading, understanding, and following the syllabus.

: AM ☐ / PM ☐ – : AM ☐ / PM ☐

Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐

COURSE PREREQUISITES

None

COURSE DESCRIPTION

This course is an introduction to applied discrete mathematics as it relates to computer engineering. Topics include set theory, propositional logic, functions, relations, recursion, Boolean algebra, applications of elementary graph theory, trees, and mathematical techniques for algorithm analysis.

STUDENT LEARNING OBJECTIVES/OUTCOMES (SLO)

Learning outcomes should be specific, measurable, and focused on the content knowledge the students are expected to master and not what the faculty will teach.

If the course is a General Education Course, the SLO should be listed and labeled as "General Education."

SLO 1: Apply basic arithmetic as relates to representing and determining the properties of positive integers
SLO 2: Apply propositional logic to practical problems modeling and analysis
SLO 3: Utilize mathematical reasoning to read, comprehend, and construct logical arguments
SLO 4: Utilize knowledge different basic discrete structures to model, analyze, and solve computing related problems
SLO 5: Solve large-value counting problems related to computing based on fundamental counting theorems
SLO 6: Apply mathematical induction and recursion to solve problems involving number sequences related to computing
SLO 7: Synthesize and analyze diagrams the model the relationships between discrete objects
SLO 8: Synthesize and analyze tree graphs that represent practical computing-related systems
SLO 9: Model and verify computing algorithm operation using pseudo code along with basic mathematics
SLO 10: Model and analyze computation using finite state machines
SLO 11: Apply discrete mathematics to practical scenarios

REQUIRED TEXTBOOKS AND MATERIALS

Any course-level subscriptions and tools linked in Blackboard Learn learning management system (LMS) should be listed here. The Blackboard LMS must have links to their student data privacy statement.

REQUIRED TEXTS:

Sandy Irani (2020) *Discrete Mathematics,* ZyBooks

REQUIRED MATERIALS:

SUGGESTED COURSE MATERIALS

SUGGESTED READINGS/TEXTS:

Rosen, K. H., & Krithivasan, K. (2012). *Discrete mathematics and its applications: With combinatorics and graph theory*. Tata McGraw-Hill Education.

Epp, S. (2019). *Discrete mathematics with applications*. Brooks/Cole Publishing Company, Pacific Grove, California

Du, D., & Ko, K. (2004). *Problem solving in automata, languages, and complexity*. John Wiley & Sons.

SUGGESTED MATERIALS:

GRADING POLICY

ASSIGNMENTS AND GRADING POLICY

94% and above	A		76% - 74%	C
93% - 90%	A-		73% - 70%	C-
89% - 87%	B+		69% - 67%	D+
86% - 84%	B		66% - 64%	D
83% - 80%	B-		63% - 0%	F
79% - 77%	C+			

For GRADUATE COURSES: See 2019-2020 Graduate Catalog p.38 for graduate grading scale and Non-Graded Courses

GRADING ALLOCATION

Course grades are based on a weighted grading scale of 100%. The breakdown for the course is as follows: *[Faculty, please adjust according to your course.]*

Category	# of Activities	Percentage Grade Weight
Discussion Boards	6	15%
Homework (Zybooks)	5	20%
Quizzes	5	15%
Exams	2	30%
Final Exam	1	20%
Total	**19**	**100%**

COURSE POLICIES

USE OF BLACKBOARD AS THE LEARNING MANAGEMENT SYSTEM

Blackboard is the primary online instructional and course communications platform. Students can access the course syllabus, assignments, grades, and learner support resources. Students are encouraged to protect their login credentials, complete a Blackboard orientation, and log in daily to the course.

Note: Uploading assignments through Blackboard presents a challenge for Chromebook users in locating the files for submission. If you use a Chromebook, please be sure you also have access to a Mac computer or Windows computer so you can fully participate in your Blackboard class. For more information about student computer recommendations, please visit https://hub.ncat.edu/administration/its/computer-recommendations.php.

MAKE-UP EXAMS

See << Update Academic Year >>*Undergraduate Bulletin:*

https://www.ncat.edu/provost/academic-affairs/bulletins/index.php

For GRADUATE STUDENTS: See 2019-20 Graduate Catalog p. 54

EXTRA CREDIT

LATE WORK

SPECIAL ASSIGNMENTS

For GRADUATE STUDENTS: FAILING TO MEET COURSE REQUIREMENTS (Graduate Catalog p.40)

For GRADUATE STUDENTS: CLASS ATTENDANCE (see 2019-20 Graduate Catalog p. 53-54)

Students are expected to attend class and participate on a regular basis in order to successfully achieve course learning outcomes and meet federal financial aid requirements (34 CFR 668.22). Class attendance in online courses is defined as active participation in academically-related course activities. Active participation may consist of course interactions with the content, classmates, and/or the instructor. Examples of academically-related course activities include, but are not limited to:

- Completing and submitting assignments, quizzes, exams, and other activities within Blackboard or through Blackboard (3rd-party products).
- Participating in course-related synchronous online chats, discussions, or meeting platforms such as Blackboard Collaborate in which participation is tracked.

CLASSROOM CITIZENSHIP

Courtesy, civility, and respect must be the hallmark of your interactions.

COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT

North Carolina A&T State University is committed to following the requirements of the Americans with Disabilities Act Amendments Act (ADAAA) and Section 504 of the Rehabilitation Act.
If you need an academic accommodation based on the impact of a disability, you must initiate the request with the Office of Accessibility Resources (OARS) and provide documentation in accordance with the Documentation Guidelines at N.C. A&T. Once documentation is received, it will be reviewed. Once approved, you must attend a comprehensive meeting to receive appropriate and reasonable accommodations. If you are a student registered with OARS, you must complete the Accommodation Request Form to have accommodations sent to faculty.

OARS is located in Murphy Hall, Suite 01 and can be reached at 336-334-7765, or by email at accessibilityresources@ncat.edu. Additional information and forms can be found on the internet at https://www.ncat.edu/provost/academic-affairs/accessibility-resources/index.php.

Please note: Accommodations are not retroactive and begin once the Disability Verification Form is provided to faculty.

TITLE IX

North Carolina A&T State University is committed to providing a safe learning environment for all students—free of all forms of discrimination and harassment. Sexual misconduct and relationship violence in any form are inconsistent with the university's mission and core values, violates university policies, and may also violate federal and state law. Faculty members are considered "Responsible Employees" and are required to report incidents of sexual misconduct and relationship violence to the Title IX Coordinator. If you or someone you know has been impacted by sexual harassment, sexual assault, dating or domestic violence, or stalking, please visit the Title IX website to access information about university support and resources. If you would like to speak with someone confidentially, please contact Counseling Services at 336-334-7727 or the Student Health Center at 336-334-7880.

TECHNICAL SUPPORT

If you experience any problems with your A&T account, you may call Client Technology Services (formerly Aggie Tech Support and Help Desk) at 336-334-7195, or visit https://hub.ncat.edu/administration/its/dept/ats/index.php.

FIELD TRIP POLICIES / OFF-CAMPUS INSTRUCTION AND COURSE ACTIVITIES

If applicable:

Off-campus, out-of-state, foreign instruction, and activities are subject to state law and university policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at https://www.ncat.edu/campus-life/student-affairs/index.php.

STUDENT HANDBOOK

https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

STUDENT TRAVEL PROCEDURES AND STUDENT TRAVEL ACTIVITY WAIVER

https://hub.ncat.edu/administration/student-affairs/staff-resources/studen_activity_travel_waiver.pdf

OTHER POLICIES *(e.g., Copyright Guidelines, Confidentiality, etc.)*

STUDENT HANDBOOK

https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

Graduate Catalog

SEXUAL MISCONDUCT POLICY

https://www.ncat.edu/legal/title-ix/sexual-harassment-and-misconduct-policies/index.php

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)

https://www.ncat.edu/registrar/ferpa.php

STUDENT COMPLAINT PROCEDURES

https://www.ncat.edu/current-students/student-complaint-form.php

STUDENT CONDUCT AND DISCIPLINE

North Carolina A&T State University has rules and regulations that govern student conduct and discipline meant to ensure the orderly and efficient conduct of the educational enterprise. It is the responsibility of each student to be knowledgeable about these rules and regulations.

Please consult the following about specific policies such as academic dishonesty, cell phones, change of grade, disability services, disruptive behavior, general class attendance, grade appeal, incomplete grades, make-up work, student grievance procedures, withdrawal, etc.:

- Undergraduate Bulletin
  https://www.ncat.edu/provost/academic-affairs/bulletins/index.php

- Graduate Catalog
  https://www.ncat.edu/tgc/graduate-catalog/index.php

- Student Handbook
  https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

ACADEMIC DISHONESTY POLICY

Academic dishonesty includes but is not limited to the following:

1. Cheating or knowingly assisting another student in committing an act of cheating or other academic dishonesty;
2. Plagiarism (unauthorized use of another's words or ideas as one's own), which includes but is not limited to submitting exams, theses, reports, drawings, laboratory notes or other materials as one's own work when such work has been prepared by or copied from another person;
3. Unauthorized possession of exams or reserved library materials; destroying or hiding source, library or laboratory materials or experiments or any other similar actions;
4. Unauthorized changing of grades, or marking on an exam or in an instructor's grade book or such change of any grade record;
5. Aiding or abetting in the infraction of any of the provisions anticipated under the general standards of student conduct;
6. Hacking into a computer and gaining access to a test or answer key prior to the test being given. N.C. A&T reserves the right to search the emails and computers of any student suspected of such computer hacking (if a police report of the suspected hacking was submitted prior to the search); and
7. Assisting another student in violating any of the above rules.

A student who has committed an act of academic dishonesty has failed to meet a basic requirement of satisfactory academic performance. Thus, academic dishonesty is not only a basis for disciplinary action, but may also affect the evaluation of a student's level of performance. Any student who commits an act of academic dishonesty is subject to disciplinary action.

In instances where a student has clearly been identified as having committed an act of academic dishonesty, an instructor may take appropriate disciplinary action, including loss of credit for an assignment, exam, or project; or awarding a grade of "F" for the course, **subject to review and endorsement by the chairperson and dean**.

For GRADUATE STUDENTS: Reference for academic dishonesty – 2010-2020 Graduate Catalog, p.58-59

For GRADUATE STUDENTS: STUDENT RELIGIOUS OBSERVANCE (see Graduate Catalog, p.55)

ASSIGNMENTS AND ACADEMIC CALENDAR

Include topics, reading assignments, due dates, exam dates, withdrawal dates, pre-registration and registration dates, all holidays, and convocations.*

THE WEEK OF MM/DD/YY	SUBJECT	UNIT LEARNING OUTCOMES (ULO)	READING IN TEXT, ACTIVITY, HOMEWORK, EXAM
	Unit 1: Number Theory and Propositional logic	ULO 1: Convert numbers between the most common number bases used in computing. (SLO 1 & 2) ULO 2: Perform basic arithmetic operations in modulo n. (SLO 1 & 2) ULO 3: Determine if a is congruent to b modulo m (where a, b and m are all decimal numbers). (SLO 1 & 2) ULO 4: Determine whether a positive integer is a prime or composite number. (SLO 1 & 2) ULO 5: Determine if an integer divides another integer. (SLO 2) ULO 6: Translate English expressions into mathematical propositional logic statements. (SLO 2) ULO 7: Use truth tables to demonstrate the equivalence of logical statements. (SLO 2) ULO 8: Use laws of propositional logic to reduce propositional expressions and demonstrate the	1. **Read Textbook:** Sandy Irani (2020) *Discrete Mathematics,* ZyBooks a) Chapter 4: Proofs b) Chapter 5: Sets c) Chapter 6: Functions 2. **Complete:** Quiz #1 (ULO 1-10) 3. **Complete:** Discussion Board #1 (ULO 1-10) 4. **Complete:** Discussion Board #2 (ULO 1-10)

		equivalence of logic statements. (SLO 2) ULO 9: Explain how propositional logic is related to digital circuit design andBoolean Algebra. (SLO 2) ULO 10: Use predicate logic to express single variable logic propositions as math functions. (SLO 2)	
	Unit 2: Mathematical Proofs and Basic Discrete Structures	ULO 1: Mathematically express a logical argument using basic propositional operators. (SLO 3, 4) ULO 2: Identify which rule of inferences is being used in a valid argument expressed briefly in English. (SLO 3, 4) ULO 3: Apply laws of propositional logic and rules of inference to prove, or disprove, a conjecture. (SLO 3, 4) ULO 4: Identify and apply appropriate standard proof methods for proving or disproving a conjecture. (SLO 3, 4) ULO 5: Specify the memberships of sets using mathematical equations and set operators. (SLO 3, 4) ULO 6: Apply set identities to prove equalities. (SLO 3, 4) ULO 7: Specify new sets from existing sets using Venn Diagrams and	1. **Read Textbook:** Sandy Irani (2020) *Discrete Mathematics,* ZyBooks a) Chapter 4: Proofs b) Chapter 5: Sets c) Chapter 6: Function 2. **Complete:** Homework #2 (ULO 1-14) 3. **Complete:** Quiz #2 (ULO 1-14) 4. **Complete:** Discussion Board #3 (ULO 1-14)

		subset concepts. (SLO 3, 4) ULO 8: Explain what is meant by abstract set types such as empty sets, sets of sets, and the universal set. (SLO 3, 4) ULO 9: Distinguish between a set and a tuple. (SLO 3, 4) ULO 10: Explain what a function is in term sets and tuples. (SLO 3, 4) ULO 11: Determine whether a set of ordered pairs is a function. (SLO 3, 4) ULO 12: Determine the range and domain of a set of ordered pairs. (SLO 3, 4) ULO 13: Identify injective, surjective, and bijective functions. (SLO 3, 4) ULO 14: Apply inverse and composition operations to specify and analyze functions. (SLO 3, 4)	
	Unit 3: Basic Counting Techniques, Mathematical Induction, and Recursion	ULO 1: Apply the product rule to count the number of possible unique combinations of N items. (SLO 6) ULO 2: Apply combinatorial analysis to count the number of possible unique subsets of size M that can be made from distinct items of a single set of N items.	1. **Read Textbook:** Sandy Irani (2020) *Discrete Mathematics,* ZyBooks a) Chapter 7: Introduction to Counting b) Chapter 8: Induction and Recursion 2. **Complete:** Discussion Board 4 Relevance of Counting and Induction/Recursion in Computing Careers (ULO 1-12) 3. **Complete:** Homework 3 (ULO 1-12)

		(SLO 6) ULO 3: Apply the product rule to count the number of distinct ways to arrange the order of N distinct items. (SLO 6) ULO 4: Distinguish between counting problems that are solvable using the combination formula and those solvable using the permutation formula. (SLO 6) ULO 5: Use the subtraction rule to count the number of possible unique strings from a set of N characters. Evaluate the first N terms of a sequence and vice versa (given its recursive equation). (SLO 6) ULO 6: Apply the geometric series concepts to calculate the compounded interest. (SLO 6) ULO 7: Determine if a given sequence is increasing, non-increasing, or decreasing. (SLO 6) ULO 8: Apply the mathematical induction algorithm to prove mathematical equality and inequality. (SLO 6) ULO 9: Determine the initial value to be used in the basic step of an induction proof. (SLO 6)	4. **Complete:** Quiz 3 (ULO 1-12)

		ULO 10: Distinguish between all key terms used in describing the mathematical induction algorithm. (SLO 6) ULO 11: Represent a series in sigma notation. (SLO 6) ULO 12: Apply the closed form for some common summation formulas to deal with summing large subsequences. (SLO 6)	
	Unit 4: Relations, Graph Theory, and Tree Graphs	ULO 1: Distinguish between the concept of a relation between two sets and a relation on a set. (SLO 7 & 8) ULO 2: Convert between the math expression, ordered pair, list, matrix, and graphical representations of relations. (SLO 7 & 8) ULO 3: Determine which of the five basic properties of relations apply to a given relation. (SLO 7 & 8) ULO 4: Determine the basic properties of graphs such as complexity, directedness, and connectivity. (SLO 7 & 8) ULO 5: Illustrate common simple graphs of various sizes. (SLO 7 & 8) ULO 6: Explain the terms graph w.r.t. (its basic elements), edge, and	1. **Read Textbook:** Sandy Irani (2020) *Discrete Mathematics,* ZyBooks a) Chapter 9: Relations/ Digraphs b) Chapter 10: Graphs c) Chapter 11: Trees 2. **Complete:** Homework #4 (ULO 1-14) 3. **Complete:** Quiz #4 (ULO 1-14) 4. **Complete:** Discussion Board #5 (ULO 1-14)

		nodes. (SLO 7 & 8) ULO 7: Calculate the degree of a node, and the total degree of a given graph. (SLO 7 & 8) ULO 8: Apply basic definitions related to subgraphs: walk, path, and circuit. (SLO 7 & 8) ULO 9: Determine whether a given graph is a tree or not. (SLO 7 & 8) ULO 10: Distinguish between different types of nodes in a tree: leaves, children, parents, ancestors, descendants, siblings, and internal nodes. (SLO 7 & 8) ULO 11: Determine the height and level for a tree and its nodes depending on which node is chosen as the root. (SLO 7 & 8) ULO 12: Apply basic theorems and equations related to trees. (SLO 7 & 8) ULO 13: Determine whether a group of binary codes constitutes a valid binary prefix code. (SLO 7 & 8) ULO 14: Utilize a tree graph to generate a valid binary prefix code. (SLO 7 & 8)	
	Unit 5: Algorithm Basics and Finite State Machines	ULO 1: Utilize pseudocode to correctly model common computing algorithms – search,	1. **Read Textbook:** Sandy Irani (2020) *Discrete Mathematics,* ZyBooks a) Chapter 12: Computation

		max, min, sort. (SLO 9 & 10) ULO 2: Verify a common algorithm's operation based on its pseudocode. (SLO 9 & 10) ULO 3: Estimate an algorithm's complexity based on its pseudocode. (SLO 9 & 10) ULO 4: Utilize pseudocode to correctly model number theory algorithms: gcd, lcm, integer division, and modulo arithmetic. (SLO 9 & 10) ULO 5: Define the term Finite State Machine (FSM) as it relates to graph theory. (SLO 9 & 10) ULO 6: Identify algorithms that are good candidates for FSM modeling. (SLO 9 & 10) ULO 7: Create and analyze FSM diagrams for a simple application, for example, counters, parity detector, toggle light, and car door control. (SLO 9, 10 & 11) ULO 8: Create and analyze FSM diagrams to detect binary prefix codes. (SLO 9, 10 & 11)	2. **Complete:** Homework #5 (ULO 1-8) 3. **Complete:** Quiz #5 (ULO 1-8) 4. **Complete:** Discussion Board #6 (ULO 1-8) 5. **Complete:** Final Exam #1 (ULO 1-8)

** These descriptions and timelines are subject to change at the discretion of the instructor.*