REGIS UNIVERSITY

COLLEGE OF COMPUTER & INFORMATION SCIENCES

Syllabus

Course Number: MT 417
Course Title: Discrete Mathematical Structures

Course Description:

Presents tools used by mathematicians and computer scientists and emphasizes developing problem-solving ability. Topics covered include logic, set theory, counting techniques, mathematical induction, and basic properties of graphs, digraphs and trees.

Prerequisite Courses:

MT 320: Introduction to Discrete Mathematics

Course Outcomes:

Upon completion of this course, learners should be able to:

1. Demonstrate comprehension and the ability to apply propositional and predicate logic as well as to synthesize the common structure of propositional logic, Boolean Algebra, and basic set theory.
2. Express arbitrary logical relations using disjunctive normal form, identify functionally complete collections of logical operators, use logic gates to create circuits express these relations, and minimize these circuits.
3. Develop and enhance proof techniques, including: direct proof, indirect proof, proof by contradiction, and proof by induction. These proof techniques will be applied to logical, numerical, and computer based problems.
4. Apply knowledge of graphs and trees to solve problems of representation, encryption / decryption, and computation. Analyze graphs to determine shortest paths between specified vertices and to determine minimum spanning trees.
5. Apply the concept of functions and equivalence relations to model databases and analyze problems of computation modulo m in order to solve number theory and cryptographic problems.
6. Apply counting and recurrence techniques to analyze situations and algorithms.

Course Materials:

Required Texts:

Rosen, K. H. (2012). *Discrete Mathematics and Its Applications* (7th ed.). New York: McGraw Hill. ISBN: 978-0-07-338309-5 or MHID: 0-07-338309-0.

Technology Tools:

A graphing calculator is **required**. A TI-83 or TI-84 is recommended.

Pre-Assignment:

It is extremely important for this review exercise to be completed and brought to the first class session.

1. A. In your own words explain what a proposition is as opposed to different types of sentences.

   B. Which of the following sentences are propositions?

   i) Is your name Mary?
   ii) If it is cold today, then it will snow.
   iii) This year the Denver Broncos will win the Super Bowl.
   iv) $x = 4$.
   v) There exists a number greater than ten, whose square is twenty.

2. Given the following propositions:

   P: Ann is a swimmer.

   Q: Ben is a sprinter.

   R: Carl is a gymnast.

   A. Using only the letters: P, Q, and R as well as the symbols: $\neg$, $\wedge$, $\vee$, and $\rightarrow$, express the following propositions:

      i) Ann is not a swimmer, or Ben is a sprinter.
      ii) Carl is a gymnast and Ben is not a sprinter.
      iii) If Ann is a swimmer, the neither Ben is a sprinter nor is Carl a gymnast.

   B. Using the given English language propositions, what do the following logical expressions mean?

      i) $\neg R \wedge P \vee Q$
      ii) $\neg Q \rightarrow (P \wedge R)$

3. Given that the following statements are true:

   K: Donna is a pilot.

   L: Ella is an artist.

   M: Fred is a Baker.

   Are the following propositions true or false?

   A. $\neg (M \wedge \neg L)$
   B. $(K \vee \neg M) \rightarrow \neg L$
   C. $\neg K \rightarrow (L \wedge M)$

4. What are the converse, contrapositive, and inverse of each of the following propositions:

   A. If it rains tomorrow, I will wear my galoshes.
   B. If frogs had fur, then we would not have to stalk the elusive ermine.

5. Create a truth table for the following logical expression: $p \wedge (\neg q \rightarrow r) \vee \neg r$.

6. A. State De Morgan's laws.

   B. Using the propositions:

      Ann is a math major.

      Ben is a computer science major.

   Apply De Morgan's laws to find logically equivalent expressions to the following:

   i) It is not the case that both Ann is a math major, and Ben is a computer science major.
   ii) Ann is not a math major, and Ben is a computer science major.

7. For the universal set, U = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}and the following subsets:

   A = {1, 4, 7, 8}

   B = {0, 1, 5, 6, 9}

   C = {1, 2, 4, 6}

   Find the elements of the following sets:

   i) $\overline{A} \cap (B \cup C)$

   ii) $\overline{(A \cup \overline{B} \cap C)}$

8. For the set, N = { x | x $\in$ $\mathbf{Z}^+$ and x is even and x has a remainder of 2 when divided by 3}. Find all elements of the set, N, that are less than 25.

9. Describe how the following are similar:
   A. The logical negation operation and the set complement operation
   B. The logical **OR** operation and the set union operation.
   C. The logical **AND** operation and the set intersection operation.

10. Based on your prior discrete math course and your personal computing experience, how do you think that discrete math applies to computer science?

Pre-Assignment Due Dates:

Classroom-based Format: This assignment is due the first night of class.

Online Format: The instructor will specify the due date for this assignment.

Course Assignments and Activities:

(Syllabus Author: fill in Week, Topics, Readings, Activities, Assignments Due, and Points or % of Grade)

	Topics	Activities	Readings	Graded Assignments or Assessments and Associated Points
1	• Propositional and predicate logic • Functional completeness of propositional systems • Basic proof techniques	• Introductions • Review the pre-assignment. • Discuss the content of sections: 1.1 – 1.6 of the text. • Preview the homework problems and provide hints as needed.	Text: Sections 1.1, 1.2, 1.3, 1.4, 1.5, and 1.6	First Night Assignment: 40 pts. Homework: 70 pts. 1.1 40, 41 1.2 13, 19, 24 1.3 24, 30, 42, 43, 44, 46, 52 1.4 8, 10, 23, 34, 39 1.5 4, 11, 16, 37 1.6 9, 14, 16. Discussion: 10 pts.
2	• Basic Proof techniques • Boolean Algebra • Functional Completeness • Logic Gates	• Discuss the content of sections: 1.2, 1.7, 1.8, 12.1, 12.2 of the text. • Preview the homework problems and provide hints as needed.	Text Sections: 1.2, 1.7, 1.8, 12.1, and 12.2	Homework: 70 pts. 1.7 6, 8, 9, 16, 18, 25, 26 1.8 2, 6, 9, 22, 28, 40 12.1 4, 5, 12, 13 12.2 2, 3, 5 1.2 40, 41, 42 Discussion: 10 pts.
3	• Combination of logic gates • Karnaugh maps • Euler and Hamiltonian paths and circuits • Dijkstra's algorithm • Euler's Theorem for planar graphs • Graph coloring (optional)	• Discuss the content of sections: : 12.3, 12.4, 10.5, 10.6, 10.7 and optionally 10.8 of the text. • Preview the homework problems and provide hints as needed.	Text Sections: 12.3, 12.4, 10.5, 10.6, 10.7 and optionally 10.8	Homework: 70 pts. 12.3 2, 5, 6, 8, 10 12.4 2, 6, 12, 23 10.5 4, 8, 10, 32, 39 10.6 3, 8, 25 10.7 4, 7, 12 10.8 optional. Discussion: 10 pts.
4	• Applications of trees • Tree traversal • Spanning trees • Minimum Spanning Trees	• Discuss the content of sections, 11.2 – 11.5 of the text. • Preview the homework problems and provide hints as needed. • Review for the midterm exam. • Take the midterm exam.	Text Sections: 11.2, 11.3, 11.4, 11.5	Homework: 35 pts. 11.2 1, 3, 6, 20, 21, 24 11.3 8, 11, 14, 24 11.4 4, 13, 16 (for 13 only) 11.5 1, 6, 7 Discussion: 5 pts. Midterm Exam: 200 pts.

5	• Functions and relations • Equivalence relations • Integer representations • Modular arithmetic	• Discuss the content of sections, 9.1, 9.2, 9.3, 9.5, 4.1, 4.2 of the text. • Preview the homework problems and provide hints as needed.	Text Sections: 9.1, 9.2, 9.3, 9.5, 4.1, 4.2	Homework: 70 pts. 9.1 Read only 9.2 4, 7 9.3 4, 26 9.5 2, 12, 21, 36, 43 4.1 6, 10, 14, 21, 31, 38 4.2 13, 18, 22, 27, 30, 34, 35, 40, 41, 47 Discussion: 10 pts.
6	• Prime numbers, GCD, and the Euclidean algorithm • Solving congruences • Hashing functions, pseudo-random numbers and check digits • Encryption and decryption	• Discuss the content of sections, 4.3 – 4.6 of the text. • Preview the homework problems and provide hints as needed.	Text Sections: 4.3, 4.4, 4.5, 4.6	Homework: 70 pts. 4.3 5, 10, 16, 18, 24, 33, 43, 50, 54 4.4 2, 6, 7, 12, 13, 20, 33, 40, 50 4.5 4, 5, 9, 19 4.6 2, 5, 11, 14, 24, 27 Discussion: 10 pts.
7	• Recursive definition of sequences, sets, and strings • Induction proof of Fibonacci relationships • Recursive algorithms • Binomial coefficients • Generalized Permutations and Combinations	• Review the content of sections, 5.1, 5.2, 6.1, 6.2. • Discuss the content of sections, 5.3, 5.4, 6.3, 6.4, 6.5. of the text. • Preview the homework problems and provide hints as needed.	Text Sections: 5.3, 5.4, 6.3, 6.4, 6.5.	Homework: 70 pts. 5.3 12, 26, 28, 35, 39. 5.4 3, 6, 10, 18 6.3 21 a – c , 25 a – e. 6.4 2, 7, 10, 15. 6.5 4, 9, 12, 15, 22, 26, 31, 38. Discussion: 10 pts.
8	• Modeling with recurrence relations. • Algorithms using recurrence relations • Solving linear recurrence relations • Solving nonhomogeneous recurrence relations	• Discuss the content of sections, 8.1 – 8.3 of the text. • Preview the homework problems and provide hints as needed. • Review for the final exam. • Take the final exam.	Text Sections: 8.1, 8.2, 8.3.	Homework: 35 pts. 8.1 4, 7, 12, 14, 33, 54 8.2 3 a, b, 4 b, d, 8, 12, 23 8.3 3, 7, 10, 14 8.4 optional Discussion: 5 pts. Final Exam: 200 pts.
			Maximum Points Possible: 1000	

CC&IS Grading Scale

Letter Grade	Percentage	Grade Point
A	93 to 100	4.00
A–	90 to less than 93	3.67
B+	87 to less than 90	3.33
B	83 to less than 87	3.00
B–	80 to less than 83	2.67
C+	77 to less than 80	2.33
C	73 to less than 77	2.00
C–	70 to less than 73	1.67
D+	67 to less than 70	1.33
D	63 to less than 67	1.00
D-	60 to less than 63	.67
F	Less than 60	0

Additional information about grading can be found in the latest edition of the University Catalog, available at http://www.regis.edu/Academics/Course%20Catalog.aspx.

CC&IS Policies and Procedures

Each of the following CC&IS Policies & Procedures is incorporated here by reference. Students are expected to review this information each term, and agree to the policies and procedures as identified here and specified in the latest edition of the University Catalog, available at http://www.regis.edu/Academics/Course%20Catalog.aspx or at the link provided.

- The CC&IS Academic Integrity Policy.
- The Student Honor Code and Student Standards of Conduct.
- Incomplete Grade Policy, Pass / No Pass Grades, Grade Reports.
- The Information Privacy policy and FERPA. For more information regarding FERPA, visit the U.S. Department of Education.
- The HIPPA policies for protected health information. The complete Regis University HIPAA Privacy & Security policy can be found here: http://www.regis.edu/About-Regis-University/University-Offices-and-Services/Auxiliary-Business/HIPAA.aspx.
- The Human Subjects Institutional Review Board (IRB) procedures. More information about the IRB and its processes can be found here: http://regis.edu/Academics/Academic-Grants/Proposals/Regis-Information/IRB.aspx.

The CC&IS Policies & Procedures Syllabus Addendum summarizes additional important policies including, Diversity, Equal Access, Disability Services, and Attendance & Participation that apply to every course offered by the College of Computer & Information Sciences at Regis University. A copy of the CC&IS Policies & Procedures Syllabus Addendum can be found here: https://in2.regis.edu/sites/ccis/policies/Repository/CCIS%20Syllabus%20Addendum.docx.