Course Outline for: MATH 2011/CSCI 2011 Discrete Structures of Computer Science

A. Course Description

1. 4 credits
2. 4 lecture hours per week
3. Prerequisites: Math 1510
4. Co-prerequisites: None
5. MnTC Goals: 4

Concepts fundamental to the analysis of algorithms. Topics include logic, sets, methods of proof including mathematical induction, combinatorics, relations, solutions of recurrence relations, graphs and trees.

B. Date last reviewed: December 29, 2017

C. Outline of Major Content Areas

1. Formal logic
2. Basic combinatorics and set theory
3. Mathematical induction
4. Recurrence relations
5. Equivalence relations and partial orderings
6. Graphs and trees

D. Course Learning Outcomes

Upon successful completion of CSCI 2011/MATH 2011, students will be able to: (Letters in parentheses refer to student competencies of the Minnesota Transfer Curriculum, Goal 2: Critical Thinking, and Goal 4: Mathematical/Logical Reasoning.)

1. Apply the laws of logic to determine if statements are equivalent or arguments are valid. (2a,2c,4c)
2. Distinguish between universally quantified statements and existentially quantified statements and be able to negate each. (2a,2c,4b,4c)
3. Find unions, intersections, complements and differences of sets. (2a,2c,4a,4b)
4. Draw the Venn diagram for a combination of sets. (2a,2c,4a,4b)
5. Articulate the difference between relations and functions. (2a,2c,4b)
6. Determine if a function is a surjection, an injection, a bijection or invertible. (2a,2c,4d)
7. Work elementary problems with sequences and series. (2a,2c,4b,4d)
8. Determine if a function f(x) is O(g(x)) (big-O notation). (2a,2c,2d,4d)
9. Apply the Euclidean algorithm for finding the greatest common divisor of two integers. (2a,2c,4d)
10. Apply the major results of elementary number theory to computer arithmetic and cryptology. (2a,2c,4a,4d)
11. Do basic matrix arithmetic. (2a,2c,4d)
12. Apply the rules of inference to prove that an argument is valid. (2a,2c,4b)

13. Recognize and identify common fallacies in incorrect arguments. (2a,2c,4c)
14. Apply the following methods of proof when appropriate: vacuous proof, trivial proof, direct proof, indirect proof, proof by contradiction, and proof by cases. (2a,2c,4b)
15. Prove statements about integers using mathematical induction correctly. (2a,2c,4b,4c)
16. Distinguish between permutations and combinations and be able to calculate each. (2a,2c,4b,4d)
17. Calculate simple probabilities. (2a,2c,4d)
18. Apply the pigeonhole principle. (2a,2c,4b)
19. Solve recurrence relations using the techniques of substitution (iteration) and characteristic roots. (2a,2c,4b,4d)
20. Determine if a relation on a set is a partial order; construct a Hasse diagram for a partial order; use a Hasse diagram to do a topological sort of a partially ordered set. (2a,2c,4b,4d)
21. Determine if a relation is an equivalence relation; determine the partition of a set induced by an equivalence relation. (2a,2c,4b,4c)
22. Express a relation using a zero-one matrix and a graph. (2a,2c,4d)
23. Solve elementary problems in graph theory dealing with representations of graphs, connectedness, and cycles.
    a. (2a,2c,4b,4d)
24. Draw trees to model situations such as file directories and organization charts. (2a,2c,4d)
25. Traverse a tree using preorder, inorder and postorder algorithms. (2a,2c,4d)
26. Find a minimum spanning tree. (2a,2c,4d)

E. Methods for Assessing Student Learning

The instructor will choose from among various evaluation techniques including – but not limited to – in-class testing, take-home testing, assignments, quizzes, attendance, group or individual projects, and research. The instructor will also choose a method for end-of-the-semester evaluation.

F. Special Information:

Before taking CSCI 2011/MATH 2011, students should be able to demonstrate:

1. A solid background in working with integers. This background would most likely come from precalculus classes. Examples of topics would be prime and composite numbers, greatest common divisor, least common multiple, modular arithmetic.
2. An understanding of relations and functions.
3. Problem-solving skills gained from one semester of calculus.