CS 251 - Discrete Structures II, Portland Community College

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Knowledge Areas that contain topics and learning outcomes covered in the course

Knowledge Area	Total Hours of Coverage
Discrete Structures (DS)	22
Algorithms and Complexity (AL)	8

Where does the course fit in your curriculum?

CS 251 is the second course in a two-term required sequence in discrete mathematics for Computer Science transfer students. Students typically complete the sequence in their second year.

College algebra (PCC's MTH 111 course) and 1 term of programming (PCC's CS 161 course) are pre-requisites for CS 250. The second course in the sequence (CS 251) requires CS 250 as a pre-requisite.

Approximately 80 students per year complete the discrete mathematics sequence (CS 250 and CS 251).

What is covered in the course?

- Set-based theory of functions, Boolean functions
- Injection, surjection, bijection
- Function composition
- Function cardinality and computability
- General set relations
- Equivalence relations
- Total and partial orderings
- Basic counting techniques: multiplication rule, addition rule, Dirichlet's Box Principle
- Combinations and permutations
- Pascal's Formula and the Binomial Theorem
- Kolmogorov Axioms and expected value
- Markov processes
- Conditional probability and Bayes' Theorem
- Classical graph theory: Euler and Hamilton circuits
- Introduction to spectral graph theory, isomorphisms
- Trees, weighted graphs, spanning trees
- Algorithm analysis
- Formal languages
- Regular expressions
- Finite-state automata

What is the format of the course?

CS 251 is a 4 credit course with 30 lecture hours and 30 lab hours. Classes typically meet twice per week for lecture, with lab sessions completed in tutoring labs outside of lecture.

Course material is available online, but this is not a distance learning class and attendance at lectures is required.

How are students assessed?

Students are assessed using in-class exams and homework. There are 5 in-class exams that count for 40% of the student's course grade, and 5 homework assignments that account for 60% of the student's course grade. In-class exams are individual work only, while group work is permitted on the homework assignments.

It is expected that students will spend 10 to 15 hours per week outside of class time completing their homework assignments. Surveys indicate a great deal of variability in this - some students report spending 6 hours per week to complete assignments, other report 20 or more hours per week.

Course textbooks and materials

The core text is *Discrete Mathematics with Applications* by Susanna S. Epp (Brooks-Cole/Cengage Learning). The text is supplemented with instructor-developed material to address topics not covered in the core text.

Students are encouraged to use computer programs to assist in routine calculations. Many students write their own programs, some use products such as Maple or Mathematica. Most calculators are unable to perform the calculations needed for this course. No specific tools are required.

Why do you teach the course this way?

This is a transfer course designed to meet the lower-division requirements of Computer Science and Engineering transfer programs in the Oregon University System with respect to discrete mathematics. As such, it serves many masters - there is no consistent set of requirements across all OSU institutions.

The majority of Portland Community College (PCC) transfer students matriculate to Portland State University, Oregon Institute of Technology, or Oregon State University, and these institutions have the greatest influence on this course. PCC changes the course content as needed to maintain compatibility with these institutions.

The most recent major course revision occurred approximately 24 months ago, although minor changes tend to occur every Fall term. Portland State University is reviewing all of their lower-division Computer Science offerings, and when they complete their process PCC expects a major revision of CS 250 and CS 251 will be required.

Students generally consider the discrete mathematics sequence to be difficult. Most students have studied some real number algebra, analysis, and calculus, but often have very limited exposure to discrete mathematics prior to this sequence.

Body of Knowledge coverage

KA	Knowledge Unit	Topics Covered	Hours
AL	Basic Analysis	Empirical measurement and performance Time and space trade-offs in algorithms Recurrence relations Analysis of iterative and recursive algorithms	4
DS	Sets, Relations, and Functions	Reflexivity, symmetry, transitivity Equivalence relations Partial orders Surjection, injection, bijection, inverse, composition of functions	4
DS	Basics of Counting	Counting arguments: cardinality, sum and product rule, IE principle, arithmetic and geometric progressions, pigeonhole principle, permutations, combinations, Pascal's identity, recurrence relations	10

DS	Graphs and Trees	Tree, tree traversal, undirected graphs, directed graphs, weighted graphs, isomorphisms, spanning trees	4
DS	Discrete Probability	Finite probability space, events, axioms and measures, conditional probability, Bayes' Theorem, independence, Bernoulli and binomial variables, expectation, variance, conditional independence	4
AL	Basic Automata Computability and Complexity	Finite state machines, regular expressions, Halting problem	4

Additional topics
Basic linear algebra, graph spectra, Markov processes