<table>
<thead>
<tr>
<th>Dept Number</th>
<th>CS 220</th>
<th>Course Title</th>
<th>Programming with Data Structures</th>
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<tr>
<td>Semester Hours</td>
<td>4</td>
<td>Course Coordinator</td>
<td>Tessema Mengistu</td>
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<td>Catalog Description</td>
<td>Advanced programming, data structures and algorithm design. Topics included advanced language features, data abstraction and object-oriented programming, recursion, stacks, queues, linked lists, trees and graphs, sorting and searching. The course meets for three lecture hours and two laboratory hours per week.</td>
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### Textbooks


### References

### Course Learning Outcomes

- To learn data abstraction and object-oriented programming.
- To learn the fundamental data structures including stacks, queues, linked lists, and trees.
- To learn sorting and searching techniques and their analysis.
- To obtain a good foundation for further study in computer science.

### Assessment of the Contribution to Student Outcomes

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<tr>
<th>Outcome</th>
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<th>2</th>
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<tr>
<td>Assessed</td>
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### Prerequisites by Topic

CS 202 and CS 215 each with a grade of C or better.

### Major Topics Covered in the Course

1. Review of programming; arrays, structures and object oriented programming approach {3 classes}

2. Programming methodology
   - Design techniques: in-depth treatment of procedural and data abstraction, further emphasis on top-down design, choice of data structures
   - Coding: additional emphasis on programming style, object oriented programming, and documentation, information hiding
   - Correctness: testing and test data, testing end cases, debugging techniques, verification of algorithms, invariants {3 classes}

3. Data abstraction and object-oriented programming: levels of abstraction; polymorphism, inheritance, encapsulation {2 classes}

4. Reference and dynamic allocation: dynamic allocation; reference parameters {5 classes}

5. Implementation of data structures: lists and linear structures; stacks and queues; trees and graphs; hash table {14 classes}

6. Recursion
   - Implementation: memory and time considerations; simulating recursion
   - Efficiency considerations: recursive vs. iterative solutions {14 classes}
   - Searching: linear search – review of linear search, searching linked lists, analysis
   - Binary search: review of binary search of arrays, binary search trees, analysis {6 classes}

7. Searching and sorting: linear search; binary search; introduction to formal analysis of algorithms
   - N² sorts: analysis of bubble sort, insertion sort, and selection sort
   - NlogN sorts: quick sort, merge sort, analysis of these sorts {7 classes}

Latest Revision: Spring 2017