Montgomery County Community College
CIS 112
Computer Science III: Data Structures & Algorithms
3-2-2

COURSE DESCRIPTION:
Building on the concepts learned in CIS 111B, the fundamental concepts of data structures and algorithms are explored. This course will apply software engineering techniques to the design and implementation of programs that manipulate complex data structures. Effective software engineering methods are stressed as well as developing good programming style. A high-level compiler language such as Java or C++ will be used. This is the third course for computer majors.

REQUISITES:
Previous Course Requirements
* CIS 111B Computer Science II: Object-Oriented Programming with a minimum grade of "C"

Concurrent Course Requirements
None

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Demonstrate the application of fundamental data structures including stacks, queues, linked lists, hash tables and trees.	Lecture Discussion Hands-On Lab Exercises Homework Assignments Group Projects	Quizzes and Exams Hands-On Programming Projects
2. Practice principles of software engineering by designing and implementing programs with an emphasis on algorithm analysis, top-down design, and creating good documentation.	Lecture Discussion Hands-On Lab Exercises Homework Assignments Group Projects	Quizzes and Exams Hands-On Programming Projects

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
3. Design programs that demonstrate an understanding of fundamental computing algorithms such as binary search trees, depth-first traversals and breadth-first traversals.	Lecture Discussion Hands-On Lab Exercises Homework Assignments Group Projects	Quizzes and Exams Hands-On Programming projects
4. Demonstrate fundamental algorithmic strategies such as brute-force divide and conquer, backtracking, branch-and-bound and pattern matching.	Lecture Discussion Hands-On Lab Exercises Homework Assignments Group Projects	Quizzes and Exams Programming Assignments
5. Use software validation and debugging methods including generating testing plans.	Lecture Discussion Hands-On Lab Exercises Homework Assignments Group Projects	Quizzes and Exams Programming Assignments

SEQUENCE OF TOPICS:

- Review of Elementary Programming Concepts & Object-Oriented Design
- Fundamental Data Structures
    - Stack
    - Queues
    - Linked lists
    - Hash tables
    - Trees
- Fundamental Computing Algorithms
    - O(N log N)
    - Sorting algorithms
    - Hash tables
    - Collision avoidance strategies
    - Binary search trees
    - Depth-first traversals
    - Breadth-first traversals

- Recursion
  - Fundamentals
  - Recursive mathematical functions
  - Recursive procedures
  - Divide and conquer strategies
  - Recursive backtracking
- Algorithmic Analysis
  - Asymptotic analysis of upper and average complexity bounds
  - Identifying differences among best, average and worst case behaviors
  - Big “O”, little “o”, omega and theta notation
  - Empirical measurements of performance
  - Time and space tradeoffs in algorithms
  - Use of recurrence relations to analyze recursive algorithms
- Algorithmic Strategies
  - Brute-force
  - Divide-and-conquer
  - Backtracking
  - Branch-and-bound
  - Heuristics
  - Pattern matching
  - Numerical approximation
- Software Engineering
  - Software validation
  - Test plan creation
  - Test case generation
  - Object-oriented testing

LEARNING MATERIALS:
Dale, Joyce, & Weems. *Object Oriented Data Structures Using Java, Third Edition*. Jones and Bartlett.

Other learning materials may be required and made available directly to the student and/or via the College’s Libraries and/or course management system.

COURSE APPROVAL:

Prepared by: Marie Hartlein		Date: 11/1995
Revised by: Kendall Martin		Date: 4/2009
VPAA/Provost Compliance Verification:	Dr. John C. Flynn, Jr.	Date: 9/11/2009
Revised by: Kendall Martin		Date: 12/2012
VPAA/Provost or designee Compliance Verification: Victoria L. Bastecki-Perez, Ed.D.		Date: 7/11/2013
Revised by: Patricia Rahmlow		Date: 5/2017
VPAA/Provost or designee Compliance Verification:		Date: 8/21/2017

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.