GAVILAN COLLEGE
5055 Santa Teresa Blvd
Gilroy, CA 95023

# Course Outline

**COURSE:** CSIS 26 DIVISION: 50 ALSO LISTED AS:

TERM EFFECTIVE: Spring 2021 CURRICULUM APPROVAL DATE: 11/10/2020

SHORT TITLE: DISCRETE STRUCTURES

LONG TITLE: Discrete Structures

| Units | Number of Weeks | Type | Contact Hours/Week | Total Contact Hours |
|---|---|---|---|---|
| 3 | 18 | Lecture: | 3 | 54 |
| | | Lab: | 0 | 0 |
| | | Other: | 0 | 0 |
| | | Total: | 3 | 54 |

**COURSE DESCRIPTION:**

Topics covered include set theory, logic, relations and functions, mathematical induction and recursion, combinatorics, discrete probability, trees and graphs, analysis of algorithms, algebraic structures. Emphasis on topics of interest to computer science majors. This course has the option of a letter grade or pass/no pass. (C-ID: COMP 152) PREREQUISITE: CSIS 45 or CSIS 24 with a grade of 'C' or better.

PREREQUISITES:
CSIS 24 or CSIS 45

COREQUISITES:

CREDIT STATUS: D - Credit - Degree Applicable

GRADING MODES
L - Standard Letter Grade

REPEATABILITY: N - Course may not be repeated

SCHEDULE TYPES:
02 - Lecture and/or discussion
05 - Hybrid
71 - Dist. Ed Internet Simultaneous
72 - Dist. Ed Internet Delayed

**STUDENT LEARNING OUTCOMES:**

By the end of this course, a student should:

1. Describe how symbolic logic tools are used to model real-life situations, especially those relevant to computing applications.

2. Relate the ideas of mathematical induction to recursion and recursively defined structures.

3. Student can describe different traversals of trees and graphs.

4. Student can apply the binomial theorem and Bayes' theorem as appropriate.

**CONTENT, STUDENT PERFORMANCE OBJECTIVES, OUT-OF-CLASS ASSIGNMENTS**

Curriculum Approval Date: 11/10/2020

(3 hours)

Variables

- Using Variables in Mathematical Discourse
- Introduction to Universal, Existential, and Conditional Statements

The Language of Sets

- Set-Roster and Set-Builder Notations
- Subsets
- Cartesian Products

Homework: Read assigned pages in text, work assigned problems, complete programming assignments.

(3 hours)

Relations and Functions

- Definition of a Relation from One Set to Another
- Arrow Diagram of a Relation
- Definition of Function
- Function Machines
- Equality of Functions

The Logic of Compound Statements

Logical Form and Logical Equivalence

- Statements
- Compound Statements
- Truth Values
- Evaluating the Truth of More General Compound Statements
- Logical Equivalence
- Tautologies and Contradictions

Homework: Read assigned pages in text, work assigned problems, complete programming assignments.

(3 hours)

Conditional Statements

- Negation of a Conditional Statement
- The Contrapositive of a Conditional Statement
- The Converse and Inverse of a Conditional Statement
- Only If and the Biconditional
- Necessary and Sufficient Conditions

Student Performance Objectives:

- State the converse, inverse, contrapositive and negation of a conditional statement

Valid and Invalid Arguments

Modus Ponens and Modus Tollens
Additional Valid Argument Forms: Rules of Inference
Fallacies Contradictions and Valid Arguments
Student Performance Objectives: Explain whether a given argument form is valid or invalid
Homework: Read assigned pages in text, work assigned problems, complete programming assignments.
(3 hours)
The Logic of Quantified Statements
Predicates and Quantified Statements
The Universal Quantifier
The Existential Quantifier
Formal Versus Informal Language
Universal Conditional Statements
Equivalent Forms of Universal and Existential Statements
Implicit Quantification
Statements with Multiple Quantifiers
Translating from Informal to Formal Language
Ambiguous Language
Negations of Multiply-Quantified Statements
Order of Quantifiers
Formal Logical Notation
Student Performance Objectives:
State the converse, inverse, contrapositive and negation of a quantified statement
Homework: Read assigned pages in text, work assigned problems, complete programming assignments.
(3 hours)
Arguments with Quantified Statements
Universal Modus Ponens
Use of Universal Modus Ponens in a Proof
Universal Modus Tollens
Proving Validity of Arguments with Quantified Statements
Using Diagrams to Test for Validity
Creating Additional Forms of Argument
Remark on the Converse and Inverse Errors
Methods of Proof
Direct Proof and Counterexample
Definitions
Proving Existential Statements
Disproving Universal Statements by Counterexample
Proving Universal Statements
Directions for Writing Proofs of Universal Statements
Variations among Proofs
Common Mistakes
Student Performance Objective:
Student writes direct proofs
Homework: Read assigned pages in text, work assigned problems, complete programming assignments.
(3 hours)
Methods of Proof
Showing That an Existential Statement Is False
Conjecture, Proof, and Disproof

Indirect Argument: Contradiction and Contraposition
Proof by Contradiction Argument by Contraposition
Relation between Proof by Contradiction and Proof by Contraposition
Student Performance Objective:
Construct a counterexample to disprove a statement
Mathematical Induction
Principle of Mathematical Induction
Comparison of Mathematical Induction and Inductive Reasoning
Student Performance Objective:
Write inductive proofs
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)
Strong Mathematical Induction and the Well-Ordering Principle for the Integers
Defining Sequences Recursively
Definition of Recurrence Relation:
Examples of Recursively Defined Sequences
Recursive Definitions of Sum and Product
Solving Recurrence Relations by Iteration
The Method of Iteration
Using Formulas to Simplify Solutions Obtained by Iteration
Checking the Correctness of a Formula by Mathematical Induction
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)
Set Theory
Definitions and the Element Method of Proof
Subsets
Proof and Disproof
Set Equality
Venn Diagrams
Operations on Sets
The Empty Set
Partitions of Sets
Power Sets
Cartesian Products
Properties of Sets
Set Identities
Proving that a set is empty
Student Performance Objectives:
Student proves simple set identities.
Student finds complements, unions, intersections and differences of sets
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)
Disproofs, Algebraic Proofs and Boolean Algebras
Functions
Functions defined on General Sets
One-to-One and Onto, Functions
Student Performance Objective:
Student will determine whether a function is one-to-one and onto or not.

Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)
Inverse Functions
One-to-One Correspondences and Inverse Functions
Composition of Functions
    Composition of One-to-One Functions
    Composition of Onto Functions
Cardinality with Applications to Computability
Definition of Cardinal Equivalence Countable Sets
The Search for Larger Infinities
Student Performance Objective:
    Student will determine the inverses of functions.
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (4 hours)
Relations on Sets
    The Inverse of a Relation
    Directed Graph of a Relation
Reflexivity, Symmetry, and Transitivity
Equivalence Relations
Student Performance Objective:
    Student will identify relations and functions
    Student will determine whether a relation is reflexive, symmetric or transitive
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)
Counting and
Probability
    Definition of Sample Space and Event
    Probability in the Equally Likely Case
    Counting
Possibility Trees and the Multiplication Rule
Counting Elements of Disjoint Sets
    The Addition Rule
    The Difference Rule
    The Inclusion/Exclusion Rule
Student Performance Objective:
    Student will apply the rules to solve problems.
    Student will apply counting techniques to calculate the probabilities.
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)
The Pigeonhole Principle
    Statement and Discussion of the Principle
    Applications
    Decimal Expansions of Fractions
    Generalized Pigeonhole Principle
    Proof of the Pigeonhole Principle
Counting Subsets of a Set: Combinations
Homework: Read assigned pages in text, work assigned problems, complete programming assignments. (3 hours)

Pascal's Formula and the Binomial Theorem
Combinatorial Formulas
Pascal's Triangle
Algebraic and Combinatorial Proofs of Pascal's Formula
Binomial Theorem and Algebraic and Combinatorial Proofs for It
Homework: Read assigned pages in text, work assigned problems, complete programming assignments.
(3 hours)
Probability Axioms and Expected Value
Conditional Probability. Bayes' Formula, and Independent Events
Student Performance Objective:
Student can apply the binomial theorem and Bayes? theorem as appropriate.
Homework: Read assigned pages in text, work assigned problems, complete programming assignments.
(3 hours)
Graphs: Definitions and Basic Properties
Matrix Representations of Graphs
Directed Graphs
Undirected Graphs
Counting Walks of Length N
(3 hours)
Isomorphisms of Graphs
Trees
Rooted Trees
Binary Trees
Spanning Trees and Shortest Paths
Minimum Spanning Trees
Student Performance Objective:
Student can describe several different traversals of trees or graphs.
Homework: Read assigned pages in text, work assigned problems, complete programming assignments.
WEEK 18 (2 hours)
Final Exam

**METHODS OF INSTRUCTION:**
Lecture, demonstrations, programming assignments.

**OUT OF CLASS ASSIGNMENTS:**
Required Outside Hours: 108
Assignment Description:
Complete assigned programming projects.
Read assigned chapter in text.
Work the assigned problems from the relevant section of the text.

**METHODS OF EVALUATION:**

Problem-solving assignments

Percent of total grade: 75.00 %

Problem-solving demonstrations: 65% - 85% Homework problems, Quizzes, Exams, Programming Assignments

Objective examinations

Percent of total grade: 20.00 %

Objective examinations: 10% - 20% Multiple choice True/false Matching items Completion

Other methods of evaluation

Percent of total grade: 5.00 %

Other methods of evaluation: 5% - 15% Group project/homework and computer and lab activities

**REPRESENTATIVE TEXTBOOKS:**

Epp. Discrete Mathematics with Applications (most recent edition). Cengage Learning,2019.

Reading Level of Text, Grade: Reading level of text, Grade: 12+ Verified by: Verified by:ev

**RECOMMENDED TEXTBOOKS:**

Kenneth H Rosen. Discrete Mathematics and Its Applications. McGraw-Hill Education,2018.

ISBN: 978-1259676512

Reading Level of Text, Grade: 12+ Verified by: MS Word, Ellen Venable

**ARTICULATION and CERTIFICATE INFORMATION**

Associate Degree:

GAV B4, effective 201770

CSU GE:

CSU B4, effective 201670

IGETC:

IGETC 2A, effective 201670

CSU TRANSFER:

Transferable CSU, effective 202130

UC TRANSFER:

Transferable UC, effective 202130

**SUPPLEMENTAL DATA:**

Basic Skills: N
Classification: Y
Noncredit Category: Y
Cooperative Education:
Program Status: 1 Program Applicable
Special Class Status: N
CAN:
CAN Sequence:
CSU Crosswalk Course Department: COMP
CSU Crosswalk Course Number: 152
Prior to College Level: Y
Non Credit Enhanced Funding: N
Funding Agency Code: Y
In-Service: N
Occupational Course: C
Maximum Hours:
Minimum Hours:
Course Control Number: CCC000564662
Sports/Physical Education Course: N
Taxonomy of Program: 070100