I. GENERAL COURSE INFORMATION

Subject and Number: Mathematics 210
Descriptive Title: Introduction to Discrete Structures
Course Disciplines: Mathematics
Division: Mathematical Sciences

Catalog Description:
This course blends mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking and modeling to study the problems that occur in computer science and mathematics. Topics covered include: logic, sets, proofs, functions, relations, number theory, counting, probability, graphs and trees.

Conditions of Enrollment:
Prerequisite: Math 190 with a minimum grade of C

Course Length: X Full Term Other (Specify number of weeks):
Hours Lecture: 5.00 hours per week TBA
Hours Laboratory: 0 hours per week TBA
Course Units: 5.00

Grading Method: Letter
Credit Status Associate Degree Credit

Transfer CSU: X Effective Date: Prior to July 1992
Transfer UC: X Effective Date: Prior to July 1992

General Education:

El Camino College:
4B – Language and Rationality – Communication and Analytical Thinking
Term: Other:
6 – Mathematics Competency
Term: Other:

CSU GE:
B4 - Mathematics/Quantitative Thinking
Term: Fall 2000 Other:

IGETC:
2A - Mathematical Concepts and Quantitative Reasoning
Term: Fall 2000 Other:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

CONCEPTS - Students will explain and demonstrate an understanding of
the key principles of logic, number theory, combinatorics, probability and graph theory.

1. PROBLEMS - Students will use logic, functions, number theory, and combinatorics to solve a variety of problems, including application problems and computer science algorithm analysis.

2. GRAPHS - Students will analyze and solve problems in graph theory.

3. PROOFS - Students will analyze and construct proofs in logic, number theory, combinatorics, probability and graph theory.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. Use the standard operations and techniques of propositional logic and set theory to analyze statements and arguments.

   Written homework

2. Use functions, sequences, and series to analyze computer science structures such as strings and hash functions.

   Homework Problems

3. Analyze the growth of functions and the complexity of algorithms.

   Objective Exams

4. Use the Division and Euclidean algorithms, and related techniques, to find prime factorizations, least common multiples, and greatest common factors, to change bases, and to perform modular arithmetic.

   Other exams

5. Prove mathematical theorems using direct or indirect proofs, trivial proofs, proofs by contradiction or contraposition, proofs by cases, combinatorial proofs, counterexample, and mathematical induction.

   Written homework

6. Define and evaluate sequences and sets recursively.

   Objective Exams

7. Model and solve counting, combinatoric, and probability problems using permutations, combinations, inclusion-exclusion, the pigeonhole principle, and recurrence relations.

   Objective Exams

8. Represent relations using matrices and digraphs, and determine if a relation is an equivalence relation.

   Objective Exams

9. Solve problems and prove theorems in graph theory that relate to connectivity, isomorphisms, planar graphs, Euler and Hamilton paths, and spanning trees.

   Homework Problems

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	8	I	BASIC LOGIC A. Propositional logic B. Logical connectives C. Truth tables D. Normal forms (conjunctive and disjunctive) E. Validity F. Predicate logic and its limitations G. Universal and existential quantifiers H. Rules of inference, including modus ponens and modus tollens
Lecture	10	II	SETS and FUNCTIONS A. Sets and set operations, including complements B. Venn diagrams C. Cartesian products D. Power sets E. Functions and growth of functions F. Surjections, injections and bijections G. Inverses and composition H. Cardinality I. Countable and uncountable sets J. Sequences and series

Lecture	10	III	METHODS of PROOF A. Notions of implication, converse, inverse, contrapositive and negation B. The structure of mathematical proofs C. Direct proofs D. Proof by contraposition E. Proof by contradiction F. Proof by counterexample G. Well orderings
Lecture	8	IV	ALGORITHMS A. Evaluating algorithms B. Complexity of algorithms C. The Master Theorem
Lecture	8	V	NUMBER THEORY A. Integers and division B. Primes C. Modular arithmetic and exponentiation D. Greatest common divisors E. Euclidean algorithm F. Solving congruences G. Cryptography
Lecture	10	VI	BASICS of COUNTING and COMBINATORICS A. Basic counting arguments B. Sum and product rule C. Inclusion-exclusion principle D. Arithmetic and geometric progressions E. Fibonacci numbers F. Pigeonhole principle G. Permutations and combinations H. Generalized permutations and combinations I. Pascal's identity J. The Binomial Theorem

Lecture	10	VII	DISCRETE PROBABILITY A. Finite probability space B. Conditional probability C. Independent vs dependent events D. Baye's Theorem E. Integer random variables F. Expected value G. Law of Large Numbers
Lecture	6	VIII	INDUCTION AND RECURSION A. First Principle of Math Induction B. Second Principle of Math Induction (Strong) C. Recursive mathematical definitions D. Setting up and solving recurrence relations
Lecture	6	IX	RELATIONS A. Reflexivity, symmetry and transitivity B. Representations of relations C. Equivalence relations
Lecture	14	X	GRAPH THEORY and TREES A. Graph terminology B. Directed and undirected graphs C. Representations of graphs D. Graph isomorphisms E. Connectivity F. Euler and Hamilton paths G. Traversal strategies H. Spanning trees and forests I. Minimal spanning trees
Total Lecture Hours		90	
Total Laboratory Hours		0	
Total Hours		90	

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. PRIMARY METHOD OF EVALUATION:

Problem solving demonstrations (computational or non-computational)

B. **TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:**

Let P(x) be the statement "student x knows calculus" and let Q(y) be the statement "class y contains a student who knows calculus." Express each of the statements below as quantifications of P(x) and Q(y) in symbolic form, negate it, then translate the negation back to regular English.

(a) Some students know calculus

(b) Not every student knows calculus

(c) Every class has a student in it who knows calculus

(d) Every student in every class knows calculus

(e) There is at least one class with no students who know calculus

C. **COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:**

1. A bagel shop has onion, poppy seed, egg, salt, pumpernickel, sesame seed, raisin, and plain bagels. How many ways are there to choose

(a) A dozen bagels?

(b) A dozen bagels with at least one of each kind?

(c) A dozen bagels with at least three egg bagels and no more than two salt bagels.

2. A new breeding pair of rabbits is placed on an island. A pair of rabbits does not breed until they are two months old. After they are two months old, each breeding pair of rabbits produces another breeding pair each month. (a) Find a recurrence relation for the number of breeding pairs of rabbits on the island after n months, assuming that rabbits never die. (b) Find a solution to this recurrence relation.

D. **OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**

Objective Exams
Other exams
Quizzes
Written homework
Homework Problems

V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Group Activities
Lecture

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Skill practice
Required reading
Problem solving activities
Written work
Estimated Independent Study Hours per Week: 10

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
Kenneth Rosen. Discrete Mathematics and Its Applications. 8th ed. McGraw Hill, 2018.

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**

D. **OTHER REQUIRED MATERIALS**
Graphing or scientific calculator

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite	Sequential

B. Requisite Skills

Requisite Skills
1. Problem solving using a computer algebra system. MATH 190 Use computing software to solve calculus problems.
2. Knowledge of how to use theorems to solve problems and to prove theorems. MATH 190 Calculate definite integrals, both using evaluating the limit of Riemann sums and using the fundamental theorem of calculus.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification

D. Recommended Skills

Recommended Skills

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by Geoffrey Jones on 10/01/1987.

BOARD APPROVAL DATE:

LAST BOARD APPROVAL DATE: 1/2/2019

Last Reviewed and/or Revised by Gregory Fry

Date: November 14, 2018

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