

COURSE SPECIFICATION

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	Course Title	Discrete Mathematics			
2.	Originating Department	Department of Computer Science and Technology			
3.	Course Code	CS201			
4.	Credit Value	3			
5.	Course Type	Major Foundational Courses			
6.	Semester	Spring			
7.	Teaching Language	English English & Chinese			
8.	Instructor(s), Affiliation & Contact For team teaching, please list all instructors	<div style="text-align: right;">wangqi@sustech.edu.cn</div> <div>Qi Wang, Assistant Professor, Department of Computer Science and Engineering, wangqi@sustech.edu.cn</div> <div style="text-align: right;">aghandar@sustech.edu.cn</div> <div>Adam Ghandar, Assistant Professor, Department of Computer Science and Engineering, aghandar@sustech.edu.cn</div>			
9.	Tutor/TA(s), Contact	/			
10.	Maximum Enrolment () Optional				
11.	Delivery Method	/	/	/	()
		Lectures	Tutorials	Lab/Practical	Other Please specify
	Credit Hours	48			48

12. Pre-requisites or Other Academic Requirements	MA102B	A	Calculus II A
	MA103A	I-A	Linear Algebra I-A
13. Courses for which this course is a pre-requisite	CS403		Cryptography and Network Security
14. Cross-listing Dept.	Not applicable for other departments beside CSE.		

SYLLABUS

15. Course Objectives

The objective of this course is to understand and use (abstract) discrete structures that are backbones of computer science. In particular, this course is meant to introduce logic, sets and functions, mathematical proofs, complexity, number theory, induction, counting, recurrences, relations, graph theory, with an emphasis on applications in computer science.

16. Learning Outcomes

1/2

1/2

1/2

On completion of this course, the students are expected to:

1/2 be able to read, understand, and construct mathematical arguments and proofs

1/2 understand the formulation of common problems in several areas of discrete mathematics, including counting, graphs, number theory, cryptography, logic and proof, recursions, probability theory, etc.

1/2 learn a number of discrete mathematical tools and apply discrete mathematical tools to solve certain problems in computer science

17.

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

O
NP
NP
I
II
I
b
II
Bezout
n
RSA
El Gamal

I

II

I

II

Pascal

I

II

III

Roy-Warshall

Hasse

I

Hall

II

III
Hamilton
Dijkstra

I

II

Overview of Discrete Math, Propositional Logic
Introduction to Discrete Math, typical problems
Propositional logic, logical connectives, truth tables

Logical Equivalence, Predicate Logic
Application of propositional logic
Logical equivalence and proof
Limitations of propositional logic
Predicate logic, quantifiers

Logical Inference, Proof Methods
Rules of logical inferences and applications
Five methods of proof, proof exercises

Set and Functions
Set, set operations, and representations using logic
Definition of functions, one-to-one functions, onto functions

Composite Functions, Sequences, Countable Sets
Composite function, inverse function
Sequences, sum of sequences, closed-form formula
Countable sets, proofs and examples

Computational Complexity I

Big-O notation, examples of complexity

NP theory

Decision problem, optimization problem

Computational Complexity II, Number Theory I

NP-Completeness

Divisibility, modular operation, base-b representation, related algorithms

Number Theory II

Primes, greatest common divisor

Euclidean algorithm, Bezout identity

Linear congruential equation, inverse modulo n

Applications of Number Theory

Chinese remainder theory, back substitution

Pseudorandom numbers using linear congruential method

Fermat's little theorem, Euler's theorem

Primitive root

Cryptography

History of cryptography

Symmetric encryption, public-key cryptography, RSA scheme

Discrete logarithm problem, El Gamal encryption scheme

Mathematical Induction

Introduction to induction, typical proofs

Weak principle, strong principle of mathematical induction

Recurrence I

Hanoi tower and recurrence

Solving recurrences with initial conditions

Recurrence II

Solving recurrences, more examples

The master theorem

Counting I

Permutations, combinatorial numbers, the sum/product rule

Inclusion-Exclusion principle and its proof

Pigeonhole principle

Bijection principle

Counting II

Binomial coefficient and properties

Pascal identity

Combinatorial proofs

Advanced Counting Techniques

Complexity of Euclidean algorithm

Solving linear recurrence relations with initial conditions

Generating functions

Relation I

Binary relation

Properties of relation, and counting

Composite relations

Relation II

Transitive relations, properties and proofs

Transitive closure

Relational database

Relation III

Connectivity relation and transitive closure

Roy-Warshall algorithm

Equivalence relations, equivalence class

Partial ordering, Hasse diagram

Graph Theory I

Basic concepts of graph theory

Undirected graphs, directed graphs, Bipartite graphs

Matching, Hall's marriage theorem, proof

Graph Theory II

Representations of graphs, adjacency matrix, incidence matrix

Isomorphism of graphs

Path, connectivity, Euler graph

Graph Theory III

Hamilton graph

Shortest path, Dijkstra algorithm

Planar graphs, Euler formula

Graph coloring

<p>Tree I</p> <p>Basic concepts of tree</p> <p>Balanced tree and counting</p> <p>Tree II, Review Lecture</p> <p>Preorder, inorder, postorder traversal</p> <p>Minimum spanning tree and algorithms</p> <p>Depth-first search and breadth-first search</p> <p>review</p>

18. **Textbook and Supplementary Readings**

<p>Kenneth Rosen, Discrete Mathematics and Its Applications, 7th Edition, Mc Graw Hill Education, 2012</p>
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ASSESSMENT

19.

Type of Assessment	Time	% of final score	Penalty	Notes
Attendance				
Class Performance				
Quiz				
Projects				
Assignments		30%		6-7 6-7 times
Mid-Term Test		30%		Covers the first part of the course
Final Exam		40%		Covers the whole course

**Final
Presentation**

**Others (The
above may be
modified as
necessary)**

20.

GRADING SYSTEM

A.	Letter Grading
B.	/ Pass/Fail Grading

REVIEW AND APPROVAL

21.

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This Course has been approved by the following person or committee of authority

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