Pokhara University
Faculty of Science and Technology

Course No.: xxx xxx	Full marks: 100
Course title: Discrete Structure (3-1-0)	Pass marks: 45
Nature of the course: Theory	Time per period: 1 hour
Level: Undergraduate	Total Periods: 45
	Program: BE

1. Course Description

This course covers the basic principles of discrete structure that form the essential foundation for every area of computer science. This course first introduces the basics of discrete structure and then discusses the different sorts of logics along with the mathematical reasoning methods. This course also elaborates the graph theory used in today's computer science and finally introduces the language and grammars to build the automata.

2. General Objectives

The general objectives of this course are:

- To provide mathematical foundation for the computational science.
- To acquaint the student with the knowledge of propositional logic, predicate logic and mathematical reasoning in these logics.
- To make students cognizant to build the finite state automata.

3. Methods of Instruction

Lecture, Discussion, Readings and Case Study

4. Contents in Detail

Specific Objectives	Contents

• Apply the set theory, functions and basic of counting.	**Unit I: Basic Discrete Structures (8 hrs)** 1.1 Sets, Set Operations, Venn Diagram, Inclusion-Exclusion Principle and Computer Representation of Sets 1.2 Basic Concept of functions, Injective and Bijective Functions, Inverse and Composite Functions, Sketch Functions, Functions for Computer Science (Ceiling Function, Floor Function, Boolean Function, Exponential Function) 1.3 Integers and Division, Primes and Greatest Common Divisor, Extended Euclidean Algorithm 1.4 Matrices: Zero-One Matrices, Boolean Matrix Operations 1.5 Basics of Counting, Pigeonhole principle and Permutations and Combinations
• Identify the relations and their properties to deduce the closures of relations.	**Unit II: Relations (6 hrs)** 2.1 Relations and their types 2.2 Properties of Relations 2.3 Representation of relations 2.4 Closures of Relations 2.5 Equivalence Relations 2.6 Partial Orderings
• Deduce the recurrence relations.	**Unit III: Recurrence Relation (7 hrs)** 3.1 Recursive Definition of Sequences 3.2 Solution of Linear recurrence relations 3.3 Solution to Nonlinear Recurrence Relations 3.4 Application to Algorithm Analysis
• Apply the mathematical reasoning methods for reasoning in the propositional and the predicate logic.	**Unit IV: Logic, Induction and Reasoning (8 hrs)** 4.1 Propositions and Truth Functions 4.2 Propositional Logic 4.3 Propositional Equivalences 4.4 Predicate logic and Quantifiers 4.5 Deduction in Predicate logic 4.6 Rules of Inferences 4.7 Mathematical Reasoning- Direct Proof and Indirect Proof (Proof by Contradiction and Proof by Contraposition) 4.8 Mathematical Induction

• Illustrate the applications of graph theory to resolve the various real world problem.	**Unit V: Graph Theory (9 hrs)** 5.1 Graph and its types. 5.2 Graph Representation (Adjacency matrix, Incidence Matrix and Path Matrix) 5.3 Walk, Path, Trails, and Circuits (Cycle) 5.4 Regular graph, complete graph, cycle graph, connected graph, simple and bipartite graph, Eulerian Graph, Hamilton Graph 5.5 Transport Network, Max-Flow and Min-Cut Theorem 5.6 Applications of graph theory
• Deduce deterministic and non-deterministic finite automata and compare them.	**Unit VI: Language, Grammar and Automata (7 hrs)** 6.1 Language and Grammars 6.2 Language and Automata 6.3 Finite State Automata 6.4 Deterministic Finite Automata 6.5 Non-Deterministic Finite Automata 6.6 Regular Expressions

5. List of Tutorials

The various tutorial activities that suits your course should cover all the content of the course to give students a space to engage more actively with the course content in the presence of instructor/professor. The following tutorial activities of 15 hours from the exercise problems of text book (Kolman, Busby Ross., *Discrete Mathematical Structures*) should be conducted to cover the content of this course:

1. Problem solving-based Tutorials: (10 hrs)
   - Solving whether a function is injective, surjective or bijective.
   - Representing Boolean operation in Boolean matrix.
   - Solving homogenous recurrence relation with single, double (double but same), triple different roots
   - Solving nonlinear recurrence relation (quadratic, exponent, linear)
   - Solving goal related problem using rules of inference in propositional and predicate logic
   - Verifying formula using mathematical induction
   - Problems related to representing graph using incidence, path and adjacency matrix.
   - Applying max-flow min cut theorem in network graph.
   - Design of finite state automata and non-deterministic finite state automata to deterministic finite automsta conversion problems
   - Design of finite state automata to checck regular expression is accepted or not.

2. Review and Question/Answer-based Tutorials: (5 hrs)
   - Case study on real use of graph in real time scenario.
   - Students ask questions within from the course content and assignments and review key course content in preparation for tests or exams

6. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, lab reports and project works etc. The internal evaluation scheme for this course is as follows:

External Evaluation	Marks	Internal Evaluation	Weight	Marks
Semester-End Examination	50	Attendance & Class Participation	10%	
		Assignments	20%	
		Presentations/Quizzes	10%	
		Term exam	60%	
		Total Internal		50
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks in internal evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

7. Prescribed Books and References

Text Books

1. Kolman, B., Busby R. and Ross S. C. *Discrete Mathematical Structures.* New Jersey: Prentice Hall.

References

1. Rosen, K. H. *Discrete Mathematics and its Applications.* New Delhi: Tata McGraw Hill Education.
2. Johnsonbaugh, R. *Discrete Mathematics*. New York: Pearson Education.
3. Mott, J. L., Kandel, A., Baker, T. P. *Discrete Mathematics for Computer Scientists and Mathematicians*. New Delhi: Prentice Hall Education.