IT153IU - Discrete Mathematics (3,0)

1. **Name of course**: DISCRETE MATHEMATICS
2. **Course code: IT153IU**
3. **Course type:**
   - ☒ Specialization
   - ☐ Core
   - ☒ Requirement
   - ☐ Elective
4. **Number of credits:** 3 credits
   - Theory: 3 credits
   - Practice: 0 credit
5. **Prerequisite:** Calculus 1, 2, 3; C/C++ Programming
6. **Parallel teaching in the course:** None

7. Course Description: This course provides students the based knowledge of discrete mathematics. To develop the ability to reason and think mathematically and logically; and to apply this ability to analyzing and solving discrete practical problems in computer science. This is an application-oriented course based upon the study of events that occur in small, or discrete in computer science, segments in business, industry, government and the digital areas. Students will be introduced to the mathematical tools of logic and set theory, counting, number theory, and graph theory. Practical applications will be introduced throughout the course.

8. **Course objectives:**
   - Define and apply count/enumerate objects in a systematic way.
   - Identify mathematical reasoning in order to read, comprehend and construct mathematical arguments.
   - Describe to work with discrete structures and practical problems in computer science.
   - Apply algorithm thinking and modeling.
   - Apply knowledge in computer science for problems solving.
9. **Textbooks and references:**

[1] Kenneth H. Rosen, Discrete Mathematics and Its Applications, eight edition, McGraw-Hill, 2019.

References:

[1] Nguyễn Văn Sinh, Trần Mạnh Hà, Nguyễn Thị Thanh Sang, Nguyễn Minh Quân, "Nền tảng Toán học trong Công nghệ Thông tin", NXB Đại học Quốc gia TP.HCM, ISBN: 978-604-73-6518-0, 2018.

[2] Discrete Mathematics An Open Introduction. Oscar Levin, 3rd Edition 2019.

10. Learning outcomes

	Course Learning outcomes	Program Learning outcome
Knowledge	1. Understand and apply count/enumerate objects in a systematic way	(a) an ability to apply knowledge of mathematics, science, and engineering (e) an ability to identify, formulate, and solve engineering problems
	2. Understand mathematical reasoning in order to read, comprehend and construct mathematical arguments	(a) an ability to apply knowledge of mathematics, science, and engineering (b) an ability to design and conduct experiments, as well as to analyze and interpret data
	3. Understand to work with discrete structures and practical problems in computer science	(a) an ability to apply knowledge of mathematics, science, and engineering (e) an ability to identify, formulate, and solve engineering problems
Skill	4. Apply algorithm thinking and modeling	(a) an ability to apply knowledge of mathematics, science, and engineering (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
	5. Apply knowledge in computer science for problems solving	(a) an ability to apply knowledge of mathematics, science, and engineering (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Attitude	6. To develop life-long learning attitude, work-group and soft-skill in working	(i) a recognition of the need for, and an ability to engage in life-long learning and working skill.

11. Course implementation

Time: 15 weeks, 03 periods per week

Teaching and learning activities

- Classroom activities: Lectures, discussions, presentations
- Self-learning: Reading, homework
- Team work: Group assignment

12. Course outline

Week	Subject	Detail
1	Course syllabus, introduction to the discrete mathematics	- Introduction to the course - Introduction to discrete math (DM) - Application of DM to solve problem in computer science
2	Logic and propositions	- Propositional logic - Applications of Propositional Logic
3	Propositional equivalences; predicates and quantifiers	- Propositional Equivalences - Logical Equivalences - Equivalence Laws - Predicates - Practical Applications of Predicate Logic
4	Nested Quantifiers and Methods of Proof	- Nested Quantifier - Multiple quantifiers - Order of quantifiers - Mathematical reasoning - Proving Theorems
5	Number theory	- Integers, Division and Primes

		- Sequence and Summation - Algorithms and Complexity
6	Induction and recursion	- Induction - Recursion
7	Counting: The basic rules of counting, permutations and combinations	- The basic rules of counting ❖ Product rules ❖ Sum rule ❖ The Inclusion-Exclusion rule ❖ The Pigeonhole Principle - Permutations and Combinations ❖ Permutation ❖ Combination ❖ Formulas of combinations ❖ The extended combination principles
8	Counting: Enumeration	- Recursive method - Loop method
9	Advanced counting techniques	- Recurrence Relation - Solving Linear Recurrence Relations - Substitution method - Characteristic Equation - Definition of relations - Representing Relations - Properties of Relations - Operations on relations
Midterm Exam		
10	Boolean algebras	- Boolean functions - Representing Boolean functions - Logic Gates - Minimization of circuits
11	Graph theory	- Types of Graphs

		- Basic Terminology - Some Special Simple Graphs - New Graphs from Old Graphs - Representing Graphs - Adjacency Matrices - Incidence Matrices - Isomorphism of Graphs - Paths - Connectedness - Euler Paths and Circuits
12	Optimal problem solving on graphs	- Finding the shortest path ❖ Dijkstra algorithm ❖ Floyd algorithm - The minimum spanning tree ❖ Concepts and theorems ❖ Prim algorithm ❖ Kruskal algorithm - Finding the maximum flow (extend) ❖ Ford-Fulkerson algorithm
13	Introduction and application of trees	- Introduction to trees - Applications of trees
14	Searching on the tree.	- Tree traversal - Spanning trees
15	Review for final exam	
Final Exam		

13. Course Assessment:

13.1. Grading:

- One midterm exam: 35%
- One comprehensive final exam: 45%
- In-class quizzes, class participation assignment, homework and learning attitude: 20%

13.2. Assessment Plan:

No.	Assessment tasks	Assessment criteria	Level of cognitive Domain												Weight (%)
			Applying			Analyzing			Evaluating			Creating			
			MCQ	WQ	P	MCQ	WQ	P	MCQ	WQ	P	MCQ	WQ	P	
1	**- Midterm exam** **- Final exam** **- Assignment** **- Homework** **- Quiz**	Study the based knowledge of discrete mathematics. Develop the ability to reason and think mathematically and logically. study of events that occur in computer science, business, industry, government and the digital areas		x	x		x	x		x			x	x	60
2	**- Midterm exam** **- Final exam** **- Assignment** **- Homework** **- Quiz**	apply to analyzing and solving discrete practical problems in computer science		x	x		x	x		x			x	x	40
	Total														100

Note: MCQ: Multiple choice questions ; **WQ**: Writing questions; **P**: Presentation

14. Student responsibility & Policies:

- *Student responsibility:* Students are expected to spend at least 8 hours per week for self – studying. This time should be made up of reading, working on exercises and problem and group assignment.
- *Attendance:* Regular on-time attendance in this course is expected. It is compulsory that students attend at least 80% of the course to be eligible for the final examination.
- *Missed tests:* Students are not allowed to miss any of the tests (both on-going assessment and final test). There are very few exceptions. (Only with extremely reasonable excuses, e.g. certified paper from doctors, may students re-take the tests.)

Developed by:	**Last updated:** Nov, 01st 2022
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