COURSE DESCRIPTION FORM: CS-1005: Discrete Structures

INSTITUTION FAST School of Computing, National University of Computer and Emerging Sciences, Islamabad Campus

PROGRAM TO BE EVALUATED BS-AI, DS **Spring 2024**

Course Description

Course Code	CS-1005
Course Title	Discrete Structures
Credit Hours	3
Course Instructors	Saira Qamar Zonera Anjum
Grading Policy	Absolute Grading
Policy about missed assessment items in the course	Retake of missed assessment items (other than sessional/ final exam) will not be held. Student who misses an assessment item (other than sessional / final exam) is awarded zero marks in that assessment item i.e. late submission will not be accepted. For missed sessional/ final exam, exam retake/ pretake application along with necessary evidence are required to be submitted to the department secretary. The examination assessment and retake committee decides the exam retake/ pretake cases.
Course Plagiarism Policy	Plagiarism in project or sessional/ final exam will result in F grade in the course. Plagiarism in an assignment will result in zero marks in the whole assignments category.
Prerequisites by Course(s) or Topics	None
Assessment Instruments with Weights (homeworks, quizzes, sessional exams, final exam, assignments, etc.)	Assessment with the weight.

Assessment Type	**Weight**
Grand Quizzes /Assignments	10
Sessional Exams (2)	25
Quizzes	10
Class Participation	5
Final Exam	50

Course Coordinator	Saira Qamar, Zonera Anjum
URL (if any)	https://classroom.google.com/c/NjI4MTY5MTI2OTU1?cjc=uimdqd6
Course Catalog Description	'Discrete Mathematics' is the study of mathematical structures that are inherently *discretized*, i.e. have countable states. In this course, we will examine one of the central branches of Discrete Mathematics – Mathematical Logic – in the utmost detail. Topics include propositional logic, predicate logic, proof techniques, undecidability, program verification, and

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<tr><td></td><td>program proofs. The theme of the course is the rigorous treatment of computing and the realizations that emerge through formalism – as such, we will continually discuss Russel's Paradox, the Halting Problem, and Godel's Theorems. Further topics include an introduction to second-order logic.</td></tr>
<tr><td>Textbook</td><td>"Logic in Computer Science" (2nd Edition) Michael Huth, Mark Ryan.</td></tr>
<tr><td>Reference Material</td><td>"Introductory Logic and Sets for Computer Scientists". Nimal Nissanke.
"Mathematical Logic for Computer Science". Zhongwan Lu.
"Computational Complexity". Christos Papadimitriou.</td></tr>
<tr><td>Course Goals</td><td>
A. Course Learning Outcomes (CLOs)
After course completion, the students shall be able to:
1. Express a logic sentence in terms of predicates, quantifiers and logical connectives.
2. Apply formal logic proofs, logical reasoning to practical problems related to offered program
3. Apply mathematical induction to prove properties of sequences, recursive relations
4. Apply graph theory concepts to compute network related metrics and develop solutions for computing applications related to the program
B. Program Learning Outcomes (PLOs)
<table>
<tr><td>PLO 1</td><td>Computing and Artificial Intelligence Knowledge</td><td>Apply knowledge of mathematics, natural sciences, computing fundamentals, and a computing specialization to solve complex computing problems using artificial intelligence techniques.</td></tr>
<tr><td>PLO 2</td><td>Problem Analysis</td><td>Identify, formulate, research literature, and analyze complex computational problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, computing, and artificial intelligence.</td></tr>
<tr><td>PLO 3</td><td>Design/Develop Solutions</td><td>Design solutions for complex computing problems and design systems, components, and processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.</td></tr>
<tr><td>PLO 4</td><td>Investigation & Experimentation</td><td>Conduct investigation of complex computing problems using research based knowledge and research based methods</td></tr>
<tr><td>PLO 5</td><td>Modern Tool Usage</td><td>Create, select, and apply appropriate techniques, resources and modern computing and artificial intelligence tools, including prediction and modelling for complex computing problems.</td></tr>
<tr><td>PLO 6</td><td>Society Responsibility</td><td>Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal,</td></tr>
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		and cultural issues relevant to context of complex computing problems.
PLO 7	Environment and Sustainability	Understand and evaluate sustainability and impact of professional computing and artificial intelligence work in solving complex computing problems.
PLO 8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of computing and artificial intelligence practice.
PLO 9	Individual and Team Work	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PLO 10	Communication	Communicate effectively on complex computing and AI activities with the computing and artificial intelligence community and with society at large.
PLO 11	Project Management and Finance	Demonstrate knowledge and understanding of management principles and economic decision making and apply these to one's own work as a member or a team.
PLO 12	Life Long Learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.

C. Mapping of CLOs to PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CLOs	1	✓											
	2		✓										
	3		✓										
	4			✓									

Topics covered in the course
(assume 15-week instruction and 3 contact hours per week)

1. Topics to be covered:

List of Topics	No. of Weeks	Contact Hours	CLO(s)
Introduction – Discrete Mathematics, Logic, and Formalism	**0.5**	**1.5**	**1**
Fundamentals of Propositional Logic	**1**	**3**	**1**

	Propositional Logic Transformational Proofs	**1**	**3**	**2**
	Propositional Logic – Semantics, Proofs, and Tableaux	**3**	**9**	**2**
	Predicate Logic – Semantics, Proofs, and Tableaux	**3**	**9**	**1, 2**
	Mathematical Inductions	**1**	**3**	**3**
	Graph Theory	**1**	**3**	**4**
	Undecidability – the Halting Problem	**1**	**3**	**1,4**
	Fundamentals of Program Verification	**2**	**6**	**2**
	Loop Invariants and Total Correctness Proofs	**1.5**	**4.5**	**2**
	Total	**15**	**45**	

Programming Language for Assignments	None.			
Class Time Spent (in percentage)	**Theory**	**Problem Analysis**	**Solution Design**	**Social and Ethical Issues**
	55	20	20	5
Oral and Written Communications	Every student is required to submit at least __5___ written reports of typically ___5____ pages each and to make __1___ oral presentation of typically ____10___ minutes' duration.			