Course Title:	**Formal Logic**
Course Code:	CSE141
Program:	Master Degree In Computer Engineering
Department:	Computer Engineering
Course coordinator:	Dr. DHIKRA CHERMITI
Institution:	Private Higher School of Engineers of Gafsa (ESIP)

A. Course Identification

1. Credit hours: 3 (2-1-0)

2. Course type

a. College ☐ Department ■ Others ☐

b. Fundamental ■ Transversal ☐ Optional ☐

3. Level/year at which this course is offered: 01/3

4. Pre-requisites for this course (if any): Basic Mathematical, Discrete Mathematics, Basic Programming Skills

1. Mode of Instruction (mark all that apply)

2	Mode of Instruction	Contact Hours	Self-study Hours	Total workload
1	**Traditional classroom**	.....	33	78
2	**Blended**	45		
3	**E-learning**	.....		
4	**Distance learning**	.....		
5	**Other**	.....		

3. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	-
3	**Tutorial**	15
4	**Others** (specify)	-
	Total	45

B. Course Objectives and Learning Outcomes

Course Description

This course introduces formal logic, focusing on propositional and predicate logic. Students will learn about logical statements, proof methods, and reasoning techniques. Key topics include decidability, Gödel's incompleteness theorem, and resolution strategies.
The course also covers unification, sequent calculus, and automated reasoning, helping students develop skills in formal verification and logic-based problem-solving.
By the end of the course, students will be able to analyze logical statements, construct formal proofs, and apply resolution methods in logical systems.

Course Main Objective

This course aims to:

- ✓ Introduce fundamental concepts of predicate logic, including zero-order (propositional) and first-order logic.
- ✓ Develop an understanding of formal systems, decidability, and Gödel's incompleteness theorem.
- ✓ Teach proof strategies, such as sequent calculus, resolution techniques, and unification.
- ✓ Apply formal logic methods in automated reasoning, theorem proving, and problem-solving.

1. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and understanding**	
1.1	✓ Understand the fundamental principles of predicate logic, including zero-order (propositional) and first-order logic.	PLO.K1
1.2	✓ Explain key logical concepts such as validity, satisfiability, and logical consequence	
1.3	✓ Describe formal proof methods, including axiomatic systems, resolution, and sequent calculus.	
	Skills	
1.1	✓ Develop structured solutions to logical problems, demonstrating critical thinking and precision in formal reasoning.	PLO.S1
	✓ Analyze logical statements and apply formal reasoning techniques.	
5.1	✓ Implement logical reasoning strategies for automated theorem proving and formal verification.	PLO.S5

C. Course Content

No	List of Topics	Contact Hours
1	**Chapters** Chapter 1: Predicate Calculus 1. Introduction 2. Zero-order logic (propositional logic) 3. First-order predicate logic	8
2	Chapter 2: Foundations of Formal Systems 1. Introduction 2. Decidability and formal methods 3. Gödel's incompleteness theorem 4. Application to predicate calculus	8
3	Chapter 3: Resolution Methods 1. Closed resolution method 2. Unification techniques 3. Variable resolution 4. Resolution strategies	8
4	Chapter 4: Sequent Calculus 1. Sequent logic and proof construction 2. Applications in theorem proving	6
Total		30

C.2. Tutorial Content

No	List of Topics	Contact Hours
1	Tutorial 1: Introduction to Formal Logic - Logical statements and propositional logic - Logical connectors and truth tables	3
2	Tutorial 2: Predicate Logic and Logical Interpretation - First-order predicate logic - Terms, atoms, and well-formed formulas - Logical consequence and interpretation	3
3	Tutorial 3: Logical Proofs and Formal Systems - Axiomatic systems	3

	- Logical inference and deduction - Proof construction	
4	Tutorial 4: Resolution and Unification - Closed resolution method - Unification process - Variable resolution	3
5	Tutorial 5: Sequent Calculus and Applications - Sequent rules and proof strategies - Theorem proving	3
Total		15

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
PLO.K1	✓ Understand the fundamental principles of predicate logic, including zero-order (propositional) and first-order logic. ✓ Explain key logical concepts such as validity, satisfiability, and logical consequence ✓ Describe formal proof methods, including axiomatic systems, resolution, and sequent calculus.	Lecturing - Class discussions	Assignments, Quizzes, Exams,
2.0	**Skills**		
PLO.S1	✓ Develop structured solutions to logical problems, demonstrating critical thinking and precision in formal reasoning. ✓ Analyze logical statements and apply formal reasoning techniques.	- Lectures - Class discussions - Assignments - projects	Assignments, Report, Quizzes, Exams

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
PLO.S5	✓ Implement logical reasoning strategies for automated theorem proving and formal verification.		Assignments, Report, Quizzes, Exams

2. Assessment Tasks for Students

	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Practical Work (written or oral)	Weekly	00%
2	Quizzes, Homework assignments	Random	00%
3	First mid Term	8	35%
4	Final Exam	16	65%

E. Student Academic Counselling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:
- Office hours - Blackboard interface - Academic advisor - Bibliotic

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	1. Canale, Tristan, and Geoffrey Just. *Cours sur la Logique Formelle.* 24 May 2016. 2. Raymond Smullyan. *First-Order Logic.* Dover Publications, 1995. 3. Michael Huth & Mark Ryan. Logic in Computer Science: Modelling and Reasoning about Systems. Cambridge University Press, 2004. 4. George Boolos, John Burgess, & Richard Jeffrey. Computability and Logic. Cambridge University Press, 2007.
Essential References Materials	▪ NA
Electronic Materials	1. MIT OpenCourseWare – Logic for Computer Science ▪ https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2005/
Other Learning Materials	- NA

2. Facilities Required

Item	Resources
Accommodation	Classrooms, laboratories board and internet access
Technology Resources (AV, data show, Smart Board, software, etc.)	Power point data show
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Traditional Machine shop, Metrology Lab.

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Students, Faculty, Program Leaders, Peer Reviewer	Direct/Indirect
Extent of achievement of course learning outcomes.	Faculty, Program Leaders, Peer Reviewer	Direct, Indirect
Quality of Learning resources	Faculty, Program Leaders, Peer Reviewer	Direct, Indirect
Teaching and learning quality and effectiveness.	Students, Faculty Program Leaders, Peer Reviewer	Direct, Indirect

H. Specification Approval Data

Council / Committee	Computer Engineering Council
Date	11/09/2023