DSE (III.3.5) Computational Thinking and Mathematical Reasoning
Discipline Specific Elective

1. Credit Distribution of the Course

Course title & Code DSE (III.3.5)	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Computational Thinking and Mathematical Reasoning	4	2	0	2	Undergraduate	NIL

2. Learning Objectives

This course develops an understanding of how computational thinking can enhance mathematical reasoning and problem solving in learners. It examines the meta cognitive foundations of pattern recognition, abstraction, logical inference, generalization, decomposition and algorithmic generation and connects these with the structures of mathematical thinking. It proposes pedagogical strategies linking processes of computational thinking along with digital tools, modeling environments, and real classroom scenarios, Students will explore the foundations of reasoning and logic, examine classroom practices that foster these skills, and integrate the digital environments in fostering computational thinking.

3. Learning Outcomes

After completing this course, students should be able to:

- Explain the nature and key dimensions of computational thinking and its relation to mathematical structures;
- Review and reflect on major theoretical perspectives on mathematical cognition and thinking processes;
- Apply metacognition skills in delineating the process of computational thinking and algorithm building;
- Integrate computational thinking into curriculum design, lesson planning, and assessment;
- Process reflective teaching-learning practices that promote reasoning, systems of proof, and creative problem solving.

4. Syllabus **[30 hours]**

Unit I Perspectives and Foundations of Computational Thinking - Evolution of Computational Thinking (CT) and its' role in mathematical reasoning; Constructs of CT: decomposition, pattern recognition, abstraction, and algorithmic design; CT, problem-solving and creativity; Positioning CT in pedagogical structures, educational frameworks and global policy directions. **[8 hours]**

Unit II Cognitive Foundations of Mathematical Reasoning - Mathematical Reasoning (MR): inductive, dedicative, analogical, abductive; Cognitive theories on mathematical thinking (Piaget, Vygotsky, Bruner, Polya); Mathematical proofs, argumentation, reasoning and explanations; Mathematical reasoning, misconceptions and errors. **[6 hours]**

Unit III Computational Thinking and Mathematical Reasoning - Relation between computational and mathematical thinking; Abstraction and generalization in CT and MR; Algorithms generation using expressions of reasoning; Pseudocode and flow representation; Data modelling, simulation and visualization using dynamic and graphic software; Computational activities and algorithm development. **[8 hours]**

Unit IV Logical and algorithmic thinking - CT framework illustration from math curriculum; Pedagogical strategies for CT integration through reflective and evidence based classroom practices. **[8 hours]**

5. Practical **[60 hours]**

- Developing and verifying algorithm for everyday mathematical task
- Creating patterns and generalization using GeoGebra
- Visual and computational exploration using GeoGebra
- Creating flowchart with/without loops for computational approach
- Computational verification for formal mathematical proofs
- Designing CT integrated word problems
- Developing CT based project and lesson planning

6. Essential Readings

- Shute V., Sun C. & Asbell-Clarke J. (2021). *Demystifying Computational Thinking.* Educational Research Review 31.
- Stylianides A. (2020). *Reasoning and Proving in Mathematics Education.* Springer.
- Sengupta P., Farris A.V. & Lee V.R. (2022). *Integrating Computational Modelling in STEM Education.* Routledge.

7. Suggestive Readings

- Mailund, T. (2021). *Introduction to Computational Thinking*. Springer.
- Wing J.M. (2024). *Computational Thinking: A 21st-Century Skill for Everyone.* Communications of the ACM.