

# Tentative Schedule for the CIMPA School, 2026

## Lecture 1: Introduction to Combinatorics and Graph Theory

## Lecture 2: Enumerative Combinatorics

Part 1: Exact enumeration of combinatorial objects, formal powers series and symbolic methods.

Part 2: Generating functions, analytical properties, asymptotic methods for enumeration.

## Lecture 3: Graph Algorithms and Programming

## Lecture 4: Metric Graph Theory and Applications

## Lecture 5: Extremal Graph Theory

Part 1: Graph invariants/potential functions and optimisation over given families of graphs.

Part 2: Spectrum of matrices associated with graphs.

## Lecture 6: Matroid Theory

## Lecture 7: Topological Graph Theory

Date	Time	Activity	Instructor/Details
Mon, Week 1	08:00 - 10:00	<b>Opening Ceremony</b>	
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Lecture 1</b>	Prof. B. Servatius
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Lecture 2 (Part 1)</b>	Prof. F. Bassino
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Lecture 1</b>	Prof. B. Servatius
	18:00 - 20:00	Dinner	
Tues, Week 1	08:00 - 10:00	<b>Lecture 2 (Part 1)</b>	Prof. F. Bassino
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Lecture 2 (Part 2)</b>	Prof. S. Wagner
	12:00 - 14:00	Lunch	
	14:00 - 16:00	<b>Tutorial (Lecture 1)</b>	Prof. B. Servatius
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Tutorial (Lecture 2 -Part 1)</b>	Prof. F. Bassino
	18:00 - 20:00	<b>Welcome Dinner</b>	
Wed, Week 1	08:00 - 10:00	<b>Lecture 2 (Part 2)</b>	Prof. S. Wagner
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Tutorial (Lecture 1)</b>	Prof. B. Servatius
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Lecture 2 (Part 2)</b>	Prof. S. Wagner
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Tutorial (Lecture 2 -Part 1)</b>	Prof. F. Bassino
	18:00 - 20:00	Dinner	
Thurs, Week 1	08:00 - 10:00	<b>Tutorial (Lecture 2-Part 2)</b>	Prof. S. Wagner
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Lecture 3</b>	Dr. V. Misanantenaina Rakotonarivo
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Tutorial (Lecture 2-Part 2)</b>	Prof. S. Wagner

Date	Time	Activity	Instructor/Details
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Lecture 3</b>	Dr. V. Misanantenaina Rakotonarivo
	18:00 - 20:00	Dinner	
<b>Frid, Week 1</b>	08:00 - 10:00	<b>Tutorial (Lecture 3)</b>	Dr. V. Misanantenaina Rakotonarivo
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Tutorial (Lecture 3)</b>	Dr. V. Misanantenaina Rakotonarivo
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Lecture 4</b>	Prof. F. Osaye
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Parallel: Group projects</b>	
	18:00 - 20:00	Dinner	
<b>Sat, Week 1</b>	All Day	Break Day / <b>Excursion</b>	
<b>Mon, Week 2</b>	08:00 - 10:00	<b>Lecture 4</b>	Prof. F. Osaye
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Lecture 5 (Part 1)</b>	Dr. A. Dossou-Olory
	12:30 - 14:00	Coffee Break	
	14:00 - 16:00	<b>Tutorial (Lecture 4)</b>	Prof. F. Osaye
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Open forum: Mathematics in Africa; Number and Pattern in African Cultures</b>	
	18:00 - 20:00	Dinner	
<b>Tues, Week 2</b>	08:00 - 10:00	<b>Tutorial (Lecture 4)</b>	Prof. F. Osaye
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Lecture 5 (Part 1)</b>	Dr. A. Dossou-Olory
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Tutorial (Lecture 5-Part 1)</b>	Dr. A. Dossou-Olory
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Lecture 6</b>	Dr. R. Avohou
	18:00 - 20:00	Dinner	
<b>Wed, Week 2</b>	08:00 - 10:00	<b>Lecture 6</b>	Dr. R. Avohou
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Tutorial (Lecture 6)</b>	Dr. R. Avohou
	12:30 - 14:00	Coffee Break	
	14:00 - 16:00	<b>Lecture 5 (part 2)</b>	Prof. E. Andriantiana & Dr. Kenneth Dadedzi
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Lecture 5 (part 2)</b>	Prof. E. Andriantiana & Dr. Kenneth Dadedzi
	18:00 - 20:00	Dinner	
<b>Thurs, Week 2</b>	08:00 - 10:00	<b>Lecture 7</b>	Prof. J. Ben Geloun
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Lecture 7</b>	Prof. J. Ben Geloun
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Tutorial (Lecture 5 -part 2)</b>	Prof. E. Andriantiana & Dr. Kenneth Dadedzi
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Tutorial (Lecture 7)</b>	Prof. J. Ben Geloun
	18:00 - 20:00	<b>Farewell Dinner</b>	
<b>Frid, Week 2</b>	08:00 - 10:00	<b>Round Table on Gender Issues in Mathematics</b>	

Date	Time	Activity	Instructor/Details
	10:00 - 10:30	Coffee Break	
	10:30 - 12:30	<b>Presentation of the groups' projects</b>	
	12:30 - 14:00	Lunch	
	14:00 - 16:00	<b>Parallel sessions on selected topics</b>	
	16:00 - 16:30	Coffee Break	
	16:30 - 18:00	<b>Parallel sessions on selected topics</b>	
	18:00 - 20:00	Dinner	
<b>Sat, Week 2</b>	All Day	Break Day	Departure

## Lecture 1: Introduction to Combinatorics and Graph Theory

This lecture introduces participants to combinatorics and graph theory, providing a foundational understanding of these fields and their applications. It covers basic principles of counting, permutations, combinations, and the pigeonhole principle, along with real-world applications in scheduling, network design, and optimization. The fundamentals of graph theory are also explored, including definitions, properties, and key concepts like graph representations, isomorphism, and special graphs such as trees and bipartite graphs. Learning objectives include understanding basic concepts, applying techniques to solve problems, and appreciating the wide range of applications. The lecture features an interactive Q & A session and hands-on exercises to reinforce learning and engagement, laying the groundwork for more advanced topics.

## Lecture 2: Enumerative Combinatorics

This advanced course explores the techniques and principles of enumerative combinatorics, focusing on counting the number of ways certain patterns can be formed. It covers fundamental counting techniques, generating functions, recurrence relations, and advanced topics like Pólya's enumeration theorem and partition theory. Participants will master various counting principles, learn to use generating functions, solve recurrence relations, and understand advanced concepts such as asymptotic methods. The course includes interactive problem-solving sessions and case studies to apply the techniques learned, equipping participants with the skills to tackle complex counting problems in various fields.

## Lecture 3: Graph Algorithms and Programming

This session provides practical experience in implementing and understanding key graph algorithms using Python. It covers fundamental algorithms in graph theory and their real-world applications. Participants will learn about graph algorithms, Python libraries like NetworkX, shortest path algorithms (Dijkstra's, Bellman-Ford), network flow algorithms (Ford-Fulkerson, Edmonds-Karp), and graph traversal algorithms (DFS, BFS, topological sorting). The session includes hands-on exercises, collaborative projects, and Q&A sessions to reinforce learning and practical application, enhancing programming skills and understanding of algorithm applications in various domains.

## Lecture 4: Metric Graph Theory and Applications

Metric Graph Theory explores distance-based graph parameters, such as diameter, radius, and eccentricity, which play crucial roles in network analysis. These properties help identify central nodes, shortest paths, and connectivity structures, making them essential in transportation systems, communication networks, and social sciences. Applications extend to optimization problems, biological modeling, and algorithmic efficiency, demonstrating how graph-theoretic distances shape real-world structures. This lecture bridges mathematical foundations with practical applications, showing how distance metrics enhance understanding and decision-making in complex networks.

## Lecture 5: Extremal Graph Theory

This advanced course delves into extremal graph theory, focusing on the maximum or minimum properties of graphs under specific constraints. Key topics include Turán's Theorem, Ramsey Theory, and extremal functions, with discussions on real-world applications in network design, computer science, and combinatorial optimization. Participants will gain a deep understanding of fundamental theorems, develop problem-solving skills, and explore the broad applications of extremal graph theory. The course features interactive problem-solving sessions to reinforce learning and practical application. Overall, it equips participants with the skills to tackle advanced problems in this field.

## Lecture 6: Matroid Theory

This introductory course offers a comprehensive overview of matroid theory, a branch of combinatorics that extends the concept of linear independence in vector spaces to more abstract settings. The course covers basic definitions and examples, matroid representations using graphs and matrices, key theorems such as the Matroid Intersection and Union Theorems, and practical applications in optimization, network flows, and greedy algorithms. Participants will gain a solid understanding of core concepts, learn to represent matroids using various mathematical structures, and apply theoretical knowledge to solve practical problems. The course includes interactive problem-solving sessions to reinforce learning and develop practical skills, preparing participants for advanced study and research in matroid theory.

## Lecture 7: Topological Graph Theory

This advanced course delves into the intersection of graph theory and topology, focusing on the study of graphs embedded in surfaces and their topological properties. Key topics include graph embeddings on surfaces like the plane, sphere, and torus, topological invariants such as the Euler characteristic and genus, and the role of graph minors in characterizing planar graphs, including Kuratowski's theorem. The course also discusses applications in network design, molecular biology, and geometric graph theory. Participants will gain a solid understanding of embeddings, explore topological invariants, and apply theoretical concepts to solve practical problems. Interactive components include hands-on exercises and collaborative projects to reinforce learning and practical application, equipping participants with the skills to analyze and apply topological graph theory in various contexts.