Celebration of 75 Years of Mathematical Legacy

Program and Abstracts

Department of Mathematics
Addis Ababa University

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Program and Abstracts

Monday, December 29, 2025

Time	Speaker/Session	Title/Event	Remark
8:00 – 08:45	Organizing Committee	Registration & Welcome	
8:45-- 9:00	Dr. Samuel Asefa	Program Introduction	Department Chair
9:00 – 09:15	Executive Dean, CNCS and President, AAU	Welcome Address	
9:20 – 09:50	Prof. Melkamu Zeleke and Prof. Abdulkadir Hasan	Pioneers of Progress: The Legacy of Mathematics Faculty in the History of Addis Ababa University	Plenary Session
9:55 – 10:15	Dr. Yenalem Ayalew	Becoming an Impactful Professional Organization	
10:15 – 10:35		**Coffee/Tea Break**	
10:40 – 12:00	Dr. Tadesse Abdi, Dr. Yirgalem Tsegaye, and Dr. Tilahun Abebaw	Memorial Session & Panel Discussion: Tribute to past faculty & Discussion on preserving and documenting Academic Heritage	
12:00 – 12:30	Participants	Open Floor for sharing reflections	
12:30 – 14:00		**Lunch Break**	
14:00 – 14:40	Prof. Shiferaw Berhanu	Mathematics at AAU during the periods 1976- 1980 and 2007- 2025.	Keynote Speaker (Virtual)
14:45 – 15:25	Prof. Semu Mitiku	Hierarchical Multi-Agent Games and Some Applications	Invited Speaker
15:30 – 15:50		**Coffee/Tea Break**	
15:50 – 16:30	Prof. Ahmed Mohammed	On a Harnack Inequality to a Degenerate/Singular PDE	Invited Speaker (Virtual)
16:35 – 16:55	Dr. Mohammed Tessema	Introduction to SAGBI Basis	Invited Speaker
17:00 – 17:20	Dr. Fikreab Solomon	Unlocking Data Science Careers for Math Students	Invited Speaker
19:30	**Conference Dinner [Location TBA]**		

Tuesday, December 30, 2025

Time	Speaker/Session	Title/Event	Remark
8:00 – 08:30		Registration & Welcome	
8:30 – 09:10	Prof. Melkamu Zeleke	Riordan Arrays and Their Applications in Enumerative Combinatorics	Invited Speaker
9:15 – 09:55	Prof. Habtu Zegeye	Methods for Solving Inclusion Problems with Applications to Image Restoration	Invited Speaker
10:00 – 10:20		**Coffee/Tea Break**	
10:25 – 10:45	Dr. Surafel Luleseged	Inclusive examination timetabling	Invited Speaker
10:50 – 11:10	Dawit Negera	Numerical Solutions for Solving Balanced Transportation Problems	Invited Speaker
11:15 – 11:35	Dr. Tesfa Yigrem	Spectral and Iterates of Weighted Composition Operators on Harmonic Fock Spaces	Invited Speaker (Virtual)
11:40 – 12:00	Dr. Tadesse Bekesshie	Applications of Fixed-Point Theorems to the Invariant Subspace Problem	Invited Speaker
12:05 – 12:25		Discussion & Networking	
12:30 – 13:30		**Lunch Break**	
13:30 – 14:30	Presenters & Student Volunteers	Poster Presentations & Photo Exhibition (students, faculty, alumni)	
14:35 – 14:55	Dawit Abiy Hailu	Inverse Problems and AI in Modern Experimental Science	Invited Speaker
15:00 – 15:20	Dr. Kidist Maxwell	The Role of Mathematical Models for Safe and Efficient Drug Development	Invited Speaker (Virtual)
15:25 – 15:45	Dr. Henok Mawi	Optimal Transport Theory in the Design of Freeform Optical Surfaces	Invited Speaker (Virtual)
15:50 – 16:10		**Coffee/Tea Break**	
16:15 – 17:15	Prof. John Mango, Dr. Joana Amorim, and Dr. Bengt Ove Turesson	Panel Discussion: The Future of Mathematics Education and Research at AAU Invited Panelists	
17:20 – 17:30	Executive Dean, CNCS	Recognition Ceremony and Closing Remark	

Abstracts

Prof. Shiferaw Berhanu

Affiliation: University of Maryland, College Park

Title: Mathematics at AAU during the periods 1976 - 1980 and 2007- 2025

Abstract: I will share my reminiscences of studying Mathematics at AAU. I will also discuss the achievements by the doctoral program and the challenges it faces.

Prof. Semu Mitiku

Affiliation: Botswana International University of Science and Technology

Title: Hierarchical Multi-Agent Games and Some Applications

Abstract: Decision making becomes increasingly complex when multiple agents coordinate or compete under partially aligned or opposing objectives. Hierarchical multi-agent systems distribute decision power across multiple levels, enabling higher-level units to manage broader goals while delegating subtasks to lower agents.

This talk introduces Multi-Leader Multi-Follower (MLMF) games, outlines their mathematical structure, and highlights applications in economics, engineering, cyber-defense, and autonomous systems. Key components include sequential decision strategies and equilibrium computations.

Prof. Ahmed Mohammed

Affiliation: Ball State University, USA

Title: On a Harnack Inequality to a Degenerate/Singular PDE

Abstract: Harnack inequality is a fundamental tool in analysis, providing uniform control over the oscillation of non-negative solutions to elliptic and parabolic partial differential equations on

small sets. Such control is often indispensable for establishing higher regularity, compactness, and qualitative properties of solutions. Beyond its central role in analysis, Harnack inequality also has deep implications in geometry and related fields. A striking and well-known example is its use in Grigori Perelman's proof of the Poincaré Conjecture, where it served as a crucial ingredient in controlling the evolution of curvature under the Ricci flow.

In this talk, I will discuss the validity of Harnack inequality for the normalized infinity Laplacian in the presence of nonlinear lower-order gradient terms. This operator is both highly degenerate and singular, and the addition of nonlinear gradient interactions introduces further complexity. Despite these challenges, the method employed relies on tools that are considerably simpler than those traditionally used in the analysis of highly degenerate elliptic equations, yet sufficiently robust to produce new Harnack estimates.

The talk will highlight a set of recent analytical ideas that have proved effective for equations exhibiting nonlinear coupling between the solution and its gradient. These nonlinear gradient terms pose substantial difficulties: degeneracy, singularity, and nonlinearity interact in a way that amplifies the complexity of the problem, particularly for the normalized infinity Laplacian. By adapting and refining these techniques, we obtain Harnack-type estimates that both extend the existing theory and suggest new avenues for exploring nonlinear PDEs with intricate gradient structures.

Prof. Melkamu Zeleke

Affiliation: William Paterson University of New Jersey, USA

Title: Riordan Arrays and their Applications in Enumerative Combinatorics

Abstract: Riordan arrays gained attention after the seminal 1991 work of Shapiro, Getu, Woan, and Woodson, which established the foundation of the Riordan group. This group offers a powerful algebraic framework for tackling a wide range of combinatorial problems.

In this talk, we use the Lagrange Inversion Theorem for formal power series as a starting point to introduce Riordan arrays. We then explore their fundamental properties and demonstrate how these properties can be applied to solve problems in enumerative combinatorics.

Prof. Habtu Zegeye

Affiliation: Botswana International University of Science and Technology

Title: Methods for Solving Inclusion Problems with Applications to Image Restoration

Abstract: This study establishes a comprehensive framework for the Variational Inequality Problem (VIP) and its generalization, the Inclusion Problem (IP), in Hilbert spaces. We demonstrate that VIPs can be reformulated as specific instances of IPs, thereby unifying these concepts under a single, powerful analytical umbrella.

To ground the theoretical framework, we provide concrete examples from optimization theory, equilibrium problems, and fixed-point problems. We also discuss methods for establishing the existence of solutions and for their numerical approximation. As a key application, we demonstrate the role of these concepts in image restoration. The study concludes by identifying a series of open questions to stimulate and guide future research in this area.

Dr. Henok Mawi

Affiliation: Howard University, Washington, DC, USA

Title: Optimal Transport Theory in the Design of Freeform Optical Surfaces

Abstract: The theory of optimal transport has been used successfully to model several freeform lens design problems. A freeform optical surface refers to an optical surface (lensor mirror) whose shape lacks rotational symmetry. The use of such surfaces allows design of spatially efficient optical devices. In this talk, we exhibit the existence of a far field refracting lens between two media of propagation by using optimal transport framework.

Dr. Surafel Luleseged

Affiliation: Addis Ababa Science & Technology University

Title: Inclusive Examination Timetabling

Abstract: Educational evaluation is a key component of the teaching and learning process, as it helps determine students' level of understanding of the subject matter. Among the various evaluation methods, examinations are the most commonly used. Almost all educational systems incorporate examinations as part of their assessment mechanisms. In higher education institutions, final examinations are typically administered during designated blocks at the end of each semester. Scheduling these examinations, known as examination timetabling, is an essential part of planning academic activities. The timetabling process must consider several constraints, particularly the hard constraint of avoiding timetable clashes for courses taken by the same students. In some cases, soft constraints, such as maximizing the interval between consecutive exams for students, are also considered. However, traditional formulations often overlook the needs of vulnerable students who may require additional time between exams. This paper presents a mathematical model for an inclusive examination timetable that accounts for these students' needs. It also proposes heuristicbased solution methods to address the formulated problem. A numerical example is provided to illustrate both the model and the proposed solution approach.

Dr. Mohammad Tesemma

Affiliation: Spelman College, USA

Title: Introduction to SAGBI Bases

Abstract: In this presentation, I begin with a seemingly simple pair of univariate polynomials over a field and introduce a natural question concerning the subalgebra they generate. This question quickly reveals the need for modern tools from algebraic geometry. A second approach the theory of SAGBI bases (Subalgebra Analogue

of Gröbner Bases for Ideals), which will form the central theme of the talk. Once we have this motivation, I will outline some basics of SAGBI theory and illustrative examples. The remainder of the talk will focus on the work of Dawit Solomon and Mulugeta Habte, former graduate students at AAU, on SAGBI basis.

Dr. Tesfa Yigrem

Affiliation: Western Norway University of Applied Sciences

Title: Spectral and Iterates of Weighted Composition Operators on Harmonic Fock Spaces

Abstract: This presentation examines the spectral behavior and numerical range of weighted composition operators in harmonic Fock spaces. The work identifies conditions for power- boundedness and mean-ergodicity, highlighting significant structural differences compared to classical Fock spaces.

Dr. Fikreab Solomon

Affiliation: Merck, USA

Title: Unlocking Data Science Careers for Math Students: A Roadmap That Works

Abstract: A practical, experience-based guide designed for mathematics students who wish to enter the fast-growing field of data science. The talk covers the data-science workflow, essential tools and technologies, and how mathematical reasoning provides a competitive advantage in machine learning and applied AI. Attendees will learn how to build strong portfolios and navigate industry expectations.

Dr. Tadesse Bekeshie

Affiliation: Addis Ababa University

Title: Survey of applications of Fixed-Point Theorems to the Invariant Subspace Problem.

Abstract: The Invariant Subspace Problem (ISP) remains one of the most persistent challenges in operator theory. This survey reviews the role of fixed-point theorems in addressing the ISP, summarizing major developments from the 1930s to 2025. The talk presents classical and modern approaches, identifies successful applications, and outlines key open directions for future research.

Dr. Kidist Maxwell

Affiliation: Applied Research Associate (ARA), USA

Title: The Role of Mathematical Models for Safe and Efficient Drug Development

Abstract: Traditional drug discovery and development processes that rely heavily on animal preclinical studies are inefficient, expensive, and often predict human outcome poorly. As a result, advanced human-relevant in-vitro approaches (such as organ-on-a-chip technologies) are emerging as preferred tools for predictive toxicology and pharmacology. However, accurately predicting treatment outcomes requires understanding drug interactions at the molecular, cellular, and systems levels, and translating the in vitro data to biological in vivo responses. Systems-level mathematical modeling provides this crucial bridge: the mechanistic insights to translate the in vitro data and systematic characterization of the dynamic relationships between drug kinetics and biological responses in humans.

In this talk, I will provide an overview of a computational framework for modern pharmacology. As an illustration, I will present a mechanistic-dose response model that can be used to predict treatment outcomes for pulmonary edema.

Dawit Abiy Hailu

Affiliation: Helmholtz-Zentrum Hereon, Germany

Title: Inverse Problems and AI in Modern Experimental Science

Abstract: Large particle accelerators such as DESY generate extremely bright X-ray beams, which are then used for imaging and analysis of materials and structures, furthering our understanding of the world.

However, the detectors used in the experiments capture noisy, incomplete, or intensity-only information. This invites mathematical understanding. Stability, well-posedness, and noise sensitivity become the central mathematical obstacles. I present a forward-operator, guided neural-network which embeds the underlying physical principles in the training instead of depending on data. The method has been applied to accelerator-based imaging problems, recovering hidden variables such as phase or deblurred structure with higher fidelity and faster convergence than classical solvers. Integrated uncertainty quantification exposes where the inversion is well-posed and where confidence collapses, turning the output into a mathematically interpretable object rather than a black-box prediction. The results indicate that operator-aware learning can handle data regimes where standard numerical inversion becomes unstable, and that mathematically informed AI can extend the reconstruction capabilities of large-scale experimental science. This opens a clear research direction: combining inverse-problem theory with modern learning to solve high-dimensional, data-constrained problems. My target in this talk is not only to share this new emerging research topic, but to inspire fellow researchers and students at AAU, who laid a foundation to who I am now, about the many possibilities in applied mathematics and how AI can be used in these.

Dawit Negera

Affiliation: Haramaya University

Title: Numerical Solutions for Solving Balanced Transportation Problems

Abstract: In this talk, we look at methods to find the initial basic feasible solution of transportation problem using best candidates', lowest allocation and Vogel's approximation methods and the optimal solution using modified distribution method and steppingstone method. The initial basic feasible solutions obtained by the three methods were compared and a comparison of optimal solutions obtained by the two

methods was also made. To compare the efficiency of these methods, computational experiments were performed by selecting three balanced transportation problems. The analysis was performed by comparing the number of iterations required to produce the optimal solution. LINDO software (version 6) was used to find the optimal solution of transportation problems with its number of iterations to reach optimal value and the comparison graph of each method plotted by Microsoft Excel. The result of this study showed that lowest allocation method provides a better solution than best candidates' method and Vogel's approximation method in solving feasible solution of transportation problems and giving optimal solution with minimum number of iterations and sometimes gives optimal solution directly.

EMPA Executive Committee Presentation

Becoming an Impactful Professional Organization: Some Insights for/from Ethiopian Mathematics Professionals' Association

Description: The goal of this presentation is to disclose key initiatives of the Ethiopian Mathematics Professionals' Association (EMPA) in line with key insights drawn from international practices. The issue of quality in Ethiopia's education and training sectors has remained a persistent concern, despite being a top national priority. Sustainable solutions have yet to materialize. In this context, the involvement of civil societies could offer significant support. However, effective collaboration and partnership among stakeholders remain limited. Given that Mathematics is a compulsory subject in Ethiopia's education system, the role and impact of EMPA could be substantially strengthened. To explore potential strategies for improvement, we have examined the practices of prominent professional organizations, including: the American Mathematical Society (AMS), the Mathematical Association of America (MAA), the Society for Industrial and Applied Mathematics (SIAM), the International Mathematical Union (IMU), the European Mathematical Society (EMS), the London

Mathematical Society (LMS), the National Council of Teachers of Mathematics (NCTM), and the International Commission on Mathematical Instruction (ICMI). In these points of view, common working areas are identified: Educational Standards and Curriculum Development, Professional Development for Educators, Support for Research and Innovation, Promotion of Equity and Inclusion in Mathematics, Certification and Accreditation, and Public Engagement and Policy Advocacy. The takeaway lessons are labeled into grand themes: advanced research, professional development, curriculum standards, and community engagement. The conclusion is that empowering EMPA leads to enhancing the quality and impact of mathematics education in Ethiopia.

Poster Presentation Titles

	Presenter	Title
1.	**Dr. Yetneberk Kuma** (Wolkite University)	On Extremal General Multiplicative Zagreb Indices
2.	**Dr. Abdi Jamal Ahmed** (Dr.Abdulmejid Hussien College of Teacher Education)	Enhancing Education Quality Through Teacher Upgrading
3.	**Dr. Fufa Beyene** (Kotebe University of Education)	Some Families of Type B Set Partitions Counted by the Dowling Numbers
4.	**Erimyas Kefyalew** (Addis Ababa University)	Boundary asymptotic and uniqueness of large solutions to p-Laplace equations with nonlinear gradient terms

Panel Discussion

Title: The Future of Mathematics at AAU: Education, Research, Industry, and Global Collaboration

Panelists:

Prof. John Mango Magero – CoRE-MATH, Co-lead, ARUA

A Gentle Walk-through Research Collaboration and Development in the African Partners

We present the need for; partners, theory of change, graduate training, research excellence, resource mobilization, human resource, research environment/ infrastructure, quality assurance, training of high-quality graduates, local and international organizations, multidisciplinary research, Alumni network, gender and inclusive practices and further discusses obstacles to research impact for economic development in the African partners.

Dr. Joana Amorim – COO, ACTEX Learning

Mathematics and Industry Partnerships

The actuarial profession is increasingly central to global efforts to strengthen financial resilience and support sustainable development. Insurance and risk-financing mechanisms help households, businesses, and governments absorb shocks and invest with greater confidence—and development actors have emphasized that expanding effective insurance markets is not peripheral, but foundational to resilience-building. Research on the Sustainable Development Goals (SDGs) has also highlighted that insurance can be critical to achieving a subset of the SDGs and important to several others, underscoring the sector's broad development relevance.

At the heart of this agenda is actuarial education: the pipeline that develops the technical skills, professional judgment, and ethical grounding required for sustainable growth in insurance, pensions, banking, and fintech. In this session, I will share practical, globally informed considerations for launching new actuarial science programs, especially in contexts where a dedicated actuarial degree does not yet exist—while ensuring alignment with workforce needs and internationally recognized standards. Drawing on ACTEX Learning's experience supporting actuarial education worldwide, the talk will compare common education and accreditation models (exam-based pathways versus university-program pathways aligned to professional syllabi), and outline concrete steps for building a credible program: curriculum mapping to global competencies; faculty development and teachingresource strategies; assessment design and academic quality assurance; and the creation of an industry advisory structure that keeps content relevant as the local market evolves.

Dr. Bengt Ove Turesson – Head, ISP; Director, IPMS

Global Partnerships, Diaspora Engagement, and Community Impact

Strong mathematics departments are a cornerstone of national research capacity and long-term scientific development. Drawing on the International Science Program's (ISP) sustained engagement with mathematics at Addis Ababa University, and comparable experience across Eastern and West Africa, this contribution reflects on how international partnerships can support the institutional foundations of mathematics education and research.

The presentation focuses on lessons from long-term collaboration aimed at strengthening departments as institutions, rather than focusing primarily on individual capacity development. Key elements include building viable

research environments, supporting early-career mathematicians within their home institutions, and fostering regional peer networks. Experiences from Eastern and West Africa illustrate how continuity, academic ownership, and regional cooperation contribute to resilient mathematics communities. Finally, the talk considers the institutional conditions—governance, infrastructure, academic culture, and stable partnership models—required for mathematics to play a central role in Addis Ababa University's Vision 2050 and in Ethiopia's broader development ambitions.

Department of Mathematics
College of Natural & Computational Sciences
Addis Ababa University

We celebrate the 75th anniversary of the Department of Mathematics at Addis Ababa University to honor our department's rich history, from its founding in 1950 amid Ethiopia's push for higher education to its role in shaping generations of mathematicians, and envision its future by bringing together faculty, alumni, and friends from around the world.

75th Anniversary

Honoring our past, Reimagining our future.

Since 1950