



10TH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES

24-26 APRIL, 2026
Istanbul – Türkiye

PROGRAM BOOK

FACE *to* FACE





IN HONOR OF THE
70th BIRTHDAY OF
PROF. DR. ETIBAR PENAHLI

THE TENTH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES (CMES- 2026), ISTANBUL/TÜRKİYE, APRIL 24-26, 2026

The Tenth International Conference on Computational Mathematics and Engineering Sciences (CMES-2026) will be held in Beykent University from 24- to 26 April 2026 in İstanbul, Türkiye. The symposium to be held this year is also significant as it is being organised in honour of Prof. Dr Etibar Penahlı's 70th birthday. It provides an ideal academic platform for researchers and professionals to discuss recent developments in both theoretical, applied mathematics and engineering sciences. This event also aims to initiate interactions among researchers in the field of computational mathematics and their applications in science and engineering, to present recent developments in these areas, and to share the computational experiences of our invited speakers and participants.

The Organizing Committee

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MESSAGE FROM THE GENERAL CHAIRS



Dear Conference Attendees,

We are honored to welcome you to the **Tenth International Conference on Computational Mathematics and Engineering Sciences (CMES-2026)** at Beykent University from 24 to 26 April 2026 in Istanbul City, Türkiye.

CMES, founded in 2016 at Faculty of Science and Techniques Errachidia Moulay Ismail University Morocco is an annual international conference, which was very successful in the past years by providing opportunities to the participants in sharing their knowledge and informations and promoting excellent networking among different international universities. This year, the conference includes 200 extended abstracts, several submissions were received in response to the call for papers, selected by the Program Committee. The program features keynote talks by distinguished speakers such as:

Nikolay A. Kudryashov from National Research Nuclear University MEPhI, Russia; **Aly R. Seadawy** from Taibah University, Saudi Arabia; **Yeliz Karaca** from University of Massachusetts Chan Medical School, USA, **Javid Ali** from Department of Mathematics, Aligarh Muslim University, Aligarh, India; **Adil Jhangeer** from VSB-Technical University of Ostrava, Czech Republic; **Varga Kalantarov** from Koç University, Türkiye, **Yusif Gasimov** from Azerbaijan University, Azerbaijan. The conference also comprises contributed sessions, posters sessions and various research highlights.

We would like to thank the Program Committee members and external reviewers for volunteering their time to review and discuss submitted abstracts. We would like to extend special thanks to the Honorary, Scientific and Organizing Committees for their efforts in making CMES-2026 a successful event. We would like to thank all the authors for presenting their research studies during our conference. We hope that you will find CMES-2026 interesting and intellectually stimulating, and that you will enjoy meeting and interacting with researchers around the world.

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TOPICS

Control Theory,
Game Theory,
Applied Mathematics,
Financial Mathematics,
Artificial Intelligence,
Education Sciences,
Engineering Sciences,
Computer Science,
Information Technology,
Geometry and Its Applications,
Analysis and Its Applications,
Statistics and Its Applications,
Algebra and Its Applications,
Topology and Its Application,
Chaos and Dynamical Systems,
Cryptography and its Applications,
Fractional Calculus and Applications,
Economics and Econometric Studies,

Electrical and Electronic Engineering,
Defense industry and applications,
Mathematical Biology,
Computational Epidemiology,
Mathematical Chemistry,
Mathematics Education and Its Applications,
Numerical Methods and Scientific
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Linear and Nonlinear programming and
Dynamics,
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Full version of submitted papers will be published in Special Volumes of reputed journals. Procedure, Guidelines and Checklist for the preparation and submission of papers to the Proceedings of CMES-2026 can be found in the journals websites. The journals in which selected and peer-reviewed full papers of CMES-2026 will be published are as follows:

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14. COMPUTATIONAL METHODS FOR DIFFERENTIAL EQUATIONS (CMDE)

This is to announce that according to the authentication letter numbered 3/18/64395 dated 22 June 2016 issued by the Iranian Ministry of Science, Research and Technology, the Computational Methods for Differential Equations (CMDE) is ranked as “Scientific Research” Journal. Moreover, the CMDE is indexed by the well-known databases such as Web of Science, Scopus, Clarivate Analytics products and services- ESCI, ISC (Islamic World Science Citation Center), Zentralblatt, Doaj, etc. Before the review process, all papers are checked by iThenticate for plagiarism, and similarities of up to 25% are considered acceptable, taking into account author names but not including references.

<https://cmde.tabrizu.ac.ir/>



PROF. DR. ETIBAR PENAHLI

Professor Etibar Panakhov, born in 1955 in the Kalinin region of Armenia, is a renowned mathematician and an internationally recognized authority in the field of spectral theory of differential operators.

He graduated with honors from the Physics and Mathematics Boarding School in Baku in 1971 and from the Faculty of Mechanics and Mathematics of Azerbaijan State University in 1976. During his final year, he completed and defended his diploma thesis at Moscow State University. He continued his postgraduate studies at Moscow State University (1976–1980) and, in 1981, successfully defended his PhD thesis under the supervision of the prominent mathematician Professor B.M. Levitan. Since 2017, E. Panakhov, has been a Doctor of Science in Mathematics and a year later, he received a diploma as a professor of Azerbaijan.

Professor Panakhov's research has made significant contributions to the theory of direct and inverse spectral problems for differential operators. His work focuses on the spectral analysis of regular and singular Sturm–Liouville, Dirac, diffusion, and integro-differential operators, as well as inverse problems in potential theory. In recognition of the importance of his contributions, the Soviet Academy of Sciences included his work among the most significant scientific achievements of 1991.

He is the author of more than 200 scientific publications and has played a vital role in the development of the next generation of mathematicians. Under his supervision, 25 master's theses have been completed and 15 doctoral degrees awarded, with six of his students advancing to professorships.

From 1996 to 2019, Professor Panakhov served as Professor at Firat University in Elazig, Turkey, where he held key leadership roles, including Head of the Mathematics and Actuarial Departments, member of the University Senate, and advisor to the Rector on international relations with Turkic-speaking countries.

A committed leader in the global mathematical community, Professor Panakhov is a founding organizer of the Turkic World Mathematicians Society (TWMS) and served as its Vice President for over two decades, representing both Turkey and Azerbaijan. He has also been a principal organizer of multiple international TWMS congresses.

His international academic engagement includes visiting professorships in India, France, Iran, Hong Kong, Kazakhstan, and other countries, reflecting the global impact of his work.

Professor Panakhov currently serves as Co-Editor-in-Chief of the TWMS Journal of Pure and Applied Mathematics and continues to contribute actively to its advancement. He has also led the “Inverse Problems and Image Definition” Department at the Scientific Research Institute of Applied Mathematics under Baku State University and is a member of the Expert Council on Mathematics of the Higher Attestation Commission under the President of the Republic of Azerbaijan.

PLENARY & INVITED TALKS



TALK IN HONOR OF PROF. DR. ETIBAR PENAHLI

PROF.DR. VARGA KALANTAROV¹

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TALK IN HONOR OF PROF. DR. ETIBAR PENAHLI

PROF.DR. MIKHAIL BRODSKY¹

¹President at Lincoln University, Lincoln, United Kingdom

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TALK IN HONOR OF PROF. DR. ETIBAR PENAHLI

PROF. DR. YUSIF GASIMOV¹

¹ Vice-rector; Azerbaijan University, Azerbaijan

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FROM THE PAINLEVÉ TEST TO SOLUTIONS OF THE KURAMOTO–SIVASHINSKY EQUATION WITH NONLINEAR CONVECTION

PROF. DR. NIKOLAY A. KUDRYASHOV¹

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ABSTRACT

This report is devoted to the study a generalization of the Kuramoto-Sivashinsky equation in the form [1]

$$u_t + u_{xx} + \sigma u_{xxx} + u_{xxxx} + \beta uu_x + \chi(u^2)_{xx} = 0.$$

This equation is used to model processes in combustion physics, plasma physics, hydrodynamics, and other fields. Since the Cauchy problem for this equation cannot be solved by the inverse scattering transform, a traveling wave reduction is employed to seek solutions. It is shown that the equation generally fails the Painlevé test. However, we find parameter of equation values, the necessary condition for the existence of a general solution is satisfied [2]. Using the results of the Painlevé analysis, first integrals for the nonlinear ODEs are derived. The general solutions for two specific cases, each involving four arbitrary constants, are presented in terms of the Weierstrass elliptic function and the transcendental solutions of the first Painlevé equation. Furthermore, exact solutions with one and two arbitrary constants are obtained using the simplest equation method.

REFERENCES

1. Aspe H. and Depassier M. C. (1990) Evolution equation of surface waves in a convecting fluid, *Physical Review A* 22, 19008, 4135–4142.
2. Kudryashov, N.A., (2025) Painlevé test, first integrals and analytical solutions of the Korteweg de Vries Burgers equation with a nonlinear source, *Chaos, Solitons and Fractals*, 201, doi = 10.1016/j.chaos.2025.117380.G.M.



RECENT DEVELOPMENTS ON ANALYTICAL AND COMPUTATIONAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS IN PHYSICS AND ENGINEERING

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ABSTRACT

Partial differential equations have become a useful tool for describing the natural phenomena of science and engineering. Nonlinear evolution equations (NLEEs) arise in many branches of science such as mathematics, physics, mechanics, engineering, and material science. The NLEEs are widely used to describe physical phenomena in various scientific and engineering fields, such as fluid mechanics, plasma physics, optical fibres, biology, solid-state physics, etc. Exact solutions of NLEEs play an important role in the proper understanding of the mechanism of many physical phenomena and processes in various areas of natural science. They can help to analyze the stability of these solutions and the movement role of the wave by making graphs of the exact solutions. The potential topics

The main topics will be as follows:

- Methods of Mathematical Physics.
- Partial differential equations.
- Fractional partial differential equations.
- Stability analysis of dynamical system.
- Nonlinear water waves.
- Soliton solutions.
- Related topics about the partial differential equations.
- Computational fluid dynamics.
- Advanced theory of the fractal and fractional calculus.
- Methods for solving the fractal and fractional PDEs in physics and Engineering.
- Application of the fractal and fractional calculus in physics and Engineering.
- Fractal variational principle.
- Computational fluid dynamics



MATHEMATICAL NEURON–NEURAL-NETWORKS DYNAMICS WITH CONTINUOUS- AND DISCRETE- TIME MODELS IN NEUROSCIENCE, BIOLOGY AND PRECISION MEDICINE: COMPLEX FEATURE ENGINEERING AND DATA COMPLEXITY

PROF. DR. YELİZ KARACA¹

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ABSTRACT

The extraction of the association between the complex systems' components could be regarded as a challenge due to their nonlinear characteristics; thus, focusing deterministically on only one single aspect of a situation may impede the understanding of the whole system or attaining a unitary whole. Data and refining of a raw dataset emerge as one important property of feature engineering through which the features for each label are built and the data used for the feature are filtered. There could be instances when missing values may include incorrect, incomplete and non-existent information, which reduce the accuracy and performance of machine learning algorithms. For the purpose of compensating this situation, complex feature engineering, which is a process of selecting, generating or modifying features such as sets of input variables or data to facilitate machine learning models learn patterns more effectively, provides complementary solutions in unstable environments with emergent structural and behavioral patterns, where emergence refers to shifts in the whole systems behavior. The features emphasize the quintessential example of the way simplicity generates complexity in conjunction with the inquiries regarding how it is possible that patterns can emerge from randomness. Further in mathematical aspects, mathematical modeling (i.e. wavelets, fractional calculus, fractals, artificial intelligence (AI), deep learning, ensemble methods, entropy, and so on) integrated with advanced technologies has been extensively utilized to characterize complex patterns existent in different areas such as medicine, neuroscience, biology, epidemiology, signal processing, image processing, computer informatics, data science, applied sciences, engineering and other related fields. Furthermore, discrete time and continuous time are two alternative frameworks within which variables that evolve over time are modeled in mathematical dynamics. Discrete time views values of variables as occurring at distinct, separate points in time, or equivalently as being unchanged throughout each non-zero region of time or time period. This implies that time is regarded as a discrete variable. Hence, a non-time variable jumps from one value to another as time moves from one time period to the next. To put it differently, discrete signal or discrete-time signal is a time series that consists of a sequence of quantities. While system

behavior is expressed by difference equations, discrete signals are common in computational simulations and data-based modeling processes. Continuous time, on the other hand, regards variables as having a

2 particular value only for an infinitesimally short amount of time. Between any two points in time, there are an infinite number of other points, and therein, the time variable could range over the entire real number line, or depending on the context, over some subset of it such as the non-negative reals. Thus, in continuous time modeling, the system behavior is generally denoted through differential equations, and in nature, they represent most of the physical processes like fluids, mechanical systems, epidemiology, and so forth. Overall, generally discrete models signify computational and complexity power, whereas continuous models signify theoretical accuracy. For these reasons, these two approaches complement each other in modern sciences. Hidden Markov Model (HMM), as a stochastic process where implicit or latent stochastic processes can be inferred indirectly through a sequence of observed states, is proven to be an applicable mathematical model concerning uncertain phenomena toward the description and computation of complex dynamical behaviors, thereby enabling the mathematical formulation of neural dynamics across spatial and temporal scales. HMM and multifractal methods within the framework of predictive quantization complexity models have been demonstrated to provide for the differential prognosis and differentiation of the subgroups with respect to multiple sclerosis (MS) which is an autoimmune degenerative disease with time and space related dissemination, leading to neuronal apoptosis, coupled with some subtle features that could be overlooked in clinical or medical practices. Overall, it is highly essential to quantify the nonlinear brain dynamics and its anatomical structure to be able to grasp the subtle features; yet, characterization across different interacting spatio-temporal scales is involved due to the brain's operation on multiple timescales, which may pose a formidable challenge. In view of these aspects and considerations as well as based on work and research conducted, the current lecture specifically aims to facilitate multifaceted decision-making processes, optimized outcome prediction, addressing the complexity of diseases and identification of the right pre-determined features through the proper selection of the variables with respect to the related discipline based on the pertinent criteria so that the mathematical model can be established appropriately. Such factors also emphasize the interdisciplinary regimes including the medical, clinical and computer-based aspects based on mathematical modeling considering their distinctive contributions that need to be carried out appropriately in a well-poised balance and knowledge-based scheme. These can ensure the identification of the external factors triggering the diseases along with the past history thereof, which can bring about timely and accurate prediction, diagnostics, course of the disease, follow-up, efficient management while being able to maintain the life quality of the patients with optimal outcomes including life-quality, (self-)control and survival, as health primarily is at stake.

Keywords: Complex feature engineering and data complexity, Computational and mathematical biology-medicine, Mathematical modeling, Discrete-time models, Continuous-time models, Mathematical neurology; Mathematical neuron-neural-networks dynamics modeling; AI, Ensemble predictive algorithmic systems; Deep learning, Mobile cloud computing; Computational complexity; Diffusion MRI signal processing; Accurate neuron geometry models, Bloch Torrey PDE, Stochastic processes and analyses, Pre-determined features; Uncertainty quantification; Precision medicine; Multifractal and singularity analysis; Fractional calculus operators; Discrete Hidden Markov model.

REFERENCES

1. Karaca, Y., & Moonis, M. (2026). Mathematical Neuron-Neural-Networks Dynamics Modeling and Brain Complexity of Multicriteria Fractal-Based Ensemble Predictive Algorithmic Systems. *Journal of Computational and Applied Mathematics*, 117319.
2. Karaca, Y. (2023). Fractional calculus operators–Bloch–Torrey partial differential equation–artificial neural networks–computational complexity modeling of the micro–macrostructural brain tissues with diffusion MRI signal processing and neuronal multi-

components. *Fractals*, 31(10), 2340204.

3. Karaca, Y., Baleanu, D., & Karabudak, R. (2022). Hidden Markov model and multifractal method-based predictive quantization complexity models vis-à-vis the differential prognosis and differentiation of multiple sclerosis' subgroups. *Knowledge-Based Systems*, 246, 108694.

4. Karaca, Y. (2022). Theory of complexity, origin and complex systems. In *Multi-Chaos, Fractal and Multi-fractional Artificial Intelligence of Different Complex Systems* (pp. 9-20). Academic Press.

5. Karaca, Y., Moonis, M., Zhang, Y. D., & Gezgez, C. (2019). Mobile cloud computing based stroke healthcare system. *International Journal of Information Management*, 45, 250-261.

6. Karaca, Y., Moonis, M., & Baleanu, D. (2020). Fractal and multifractional-based predictive optimization model for stroke subtypes' classification. *Chaos, Solitons & Fractals*, 136, 109820.



A NOVEL APPROACH FOR CHARACTERIZING NONLINEAR DYNAMICAL SYSTEM BEHAVIOR THROUGH SELF-ORGANIZING MAPS AND CLUSTERING ANALYSIS

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Abstract

Understanding the behavior of complex nonlinear dynamical systems remains a significant challenge because of the high dimensionality and intricate interactions among system parameters. These complexities often mask the underlying dynamical patterns, making it difficult to predict and control system responses under varying conditions.

In this study, we propose a novel framework based on Self-Organizing Maps (SOMs) combined with clustering techniques to systematically characterize system behavior arising from parameter variations. The proposed approach groups dynamical responses that exhibit similar patterns and enables the identification of latent structures within the parameter space.

To further interpret the resulting clusters, we perform a detailed dynamical analysis of each group. As a case study, the methodology is applied to the FitzHugh–Nagumo model, demonstrating its effectiveness in revealing distinct behavioral regimes. The obtained results identify meaningful latent patterns and classify the parameter space into 12 major behavioral groups, reflecting the heterogeneous nature of the system dynamics.

Overall, this approach provides an effective tool for understanding how parameter variations influence system behavior and offers valuable insights for the prediction and control of complex nonlinear systems.



CONTROLLABILITY OF GENERALIZED HILFER FRACTIONAL DYNAMICAL SYSTEMS WITH DELAYS

PROF. DR. JAVID ALI¹

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Abstract

In this talk, we discuss the controllability of dynamical systems with (k, φ) -Hilfer fractional derivative with infinite delay and delay in control function. The necessary and sufficient condition obtained for the controllability requirement for linear systems, which are characterized by the Mittag-Leffler (M-L) functions, while the fixed point approach is used to arrive at adequate controllability criteria for nonlinear systems. The novel feature of this study is to inquire into the controllability notion by using (k, φ) -Hilfer fractional derivative, the most generalized variant of the Hilfer derivative. The advantage of this type of fractional derivative is that it recovers the majority of earlier studies on fractional differential equations (FDEs). Finally, few numerical examples are provided to illustrate our main results.

Keywords: Fractional dynamical systems, Controllability, Gramian matrix, Fixed point theorem, measure of non-compactness.

Day 1: 24 April 2026

10:00 - 11:00

OPENING CEREMONY

Beykent University Taksim Campus Adem Çelik Auditorium

Speakers:

Prof. Dr. Zakia HAMMOUCH - Chair of CMES, ENS Meknes, Moulay Ismail University

Prof. Dr. Varga KALANTAROV - Koc University

Prof. Dr. Mikhail BRODSKY - President Lincoln University

Prof. Dr. Yusif GASIMOV - Azerbaijan University

Assoc. Prof. Dr. Necibe NESİBOVA - Under Secretary, Embassy of Azerbaijan

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Prof. Dr. Rengin AK - Rector of Kırklareli University

Prof. Dr. Volkan ÖNGEL - Rector of Beykent University

Prof. Dr. Etibar PENAHLI - Baku State University

11:00 - 11:15

Coffee Break

11:15 - 11:45

PLENARY LECTURE - Adem Çelik Auditorium

Speaker: PROF. DR. NIKOLAY A. KUDRYASHOV

Title: FROM THE PAINLEVÉ TEST TO SOLUTIONS OF THE KURAMOTO-SIVASHINSKY EQUATION WITH NONLINEAR CONVECTION

Chair: PROF. DR. YUSIF GASIMOV

11:45 - 12:15

PLENARY LECTURE - Adem Çelik Auditorium

Speaker: PROF. DR. ALY R. SEADAWY

Title: RECENT DEVELOPMENTS ON ANALYTICAL AND COMPUTATIONAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS IN PHYSICS AND ENGINEERING

Chair: PROF. DR. VARGA KALANTAROV

12:15 - 13:45

Lunch

Beykent University Law Faculty Restaurant

AUTHORS	TITLES
Yusif Gasimov, Abdeljalil Nachaoui, Aynura Aliyeva	A NUMERICAL METHOD TO THE SOLUTION OF THE INVERSE CAUCHY PROBLEM FOT THE PAULI EQUATION
Agon Bajgora	CONSENSUS-GATED EXECUTION: A MULTI-AGENT LLM ARCHITECTURE FOR AUTONOMOUS CRYPTOCURRENCY TRADING
Sannaky Ibtissam, El Berrai Imane, Adnaoui Khalid	STOCHASTIC INSIGHTS INTO CYSTIC ECHINOCOCCOSIS CONTROL TO BREAK THE TRANSMISSION CYCLE
Coşkun Yakar, Dilara Karslıoğlu	STRICT MITTAG-LEFFLER STABILITY OF FRACTIONAL UNPERTURBED SYSTEMS WITH INITIAL TIME DIFFERENCE

AUTHORS	TITLES
Ahlam elkhettab, Imane elberrai	MODEL OF KIDNEY FUNCTION DECLINE UNDER THE INFLUENCE OF DIABETES AND HYPERTENSION
Ado Balili	DYNAMICAL BEHAVIOUR AND NEW EXACT TRAVELLING WAVE SOLUTIONS FOR THE (2+1) DIMENSIONAL FRACTIONAL STOCHASTIC DAVEY-STEWARTSON SYSTEM VIA TWO ROBUST TECHNIQUES
Muhammad Abubakar Isah, Ibrahim Isah, Ahmad Muhammad, Salim Jibrin Danbatta	EMERGENCE OF LOGARITHMIC NONLINEAR WAVES IN A LIOUVILLE MODEL: AN EXACT ANALYTICAL STUDY
Ayşe Metin Karakaş, Fatma Bulut, Bahadır Yüzbaşı	THE CAUCHY MODIFIED GARIMA DISTRIBUTION: PROPERTIES, INFERENCE, AND EMPIRICAL APPLICATIONS
Ercan Akcan, Burcu Yılmaz, Özgün Yücel	SLEEPNET NANO: AN ENHANCED 1D-CNN FOR SLEEP STAGING ON PHARMACOLOGICALLY ALTERED PSG RECORDINGS

AUTHORS	TITLES
Alan Kılıç	GLOBAL EXISTENCE AND BLOW UP OF SOLUTIONS FOR A HYPERBOLIC-TYPE EQUATION
Nursemin Kaş, Tolga Aktürk	ANALYTICAL INVESTIGATION OF NONLINEAR WAVE STRUCTURES VIA A MODIFIED EXPONENTIAL METHOD
N. M. Temirbekov, Z. I. Seitmuratova, G. B. Zhussipova	COMPARATIVE ANALYSIS OF INTERPOLATION METHODS AND MACHINE LEARNING ALGORITHMS FOR GEOCHEMICAL ANOMALIES OF ORE OBJECTS
Seyma Tülüce Demiray, Ugur Bayrakçı, Ahmet Hakan Doğan	THE SOLUTIONS OF UNIDIRECTIONAL WAVE MODEL VIA IBSEFM
Sadullah Bulut, Muhammed Yiğider	AI-SUPPORTED MODIFIED EXP-EXPANSION FUNCTION METHOD FOR NONLINEAR DYNAMICAL SYSTEMS
Binar Elmahmud, Durmuş Yarımabuç, Özlem Öcal	COMPARISON OF NUMERICAL SOLUTION METHODS IN TUMOR-IMMUNE INTERACTIONS

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Gülay Oğuz, Mahmut Dursun, Ayten Aksoy	THEORETICAL FOUNDATIONS OF SOFT NEUTROSOPHIC HYPERNEAR-RINGS
Emine Üyücü, Ummahan Aca	SOFT INT-MODULES OVER A SOFT INT-RING...
Talha Arslan	THE FAMILY OF α MONOTONE DISTRIBUTIONS: DIFFERENT ESTIMATION METHODS AND APPLICATIONS
Talha Arslan	A SKEW-UNIT-NORMAL DISTRIBUTION AND ITS APPLICATIONS

AUTHORS	TITLES
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Diana M. Audi	INSTRUCTOR-TRAINED AI TUTOR FOR MATHEMATICS EDUCATION: DESIGN AND EVALUATION OF A CUSTOM GPT
Sadi I. Haruna, Abba Bashir, Yasser E.Ibrahim, Sani I. Abba	UNCERTAINTY-AWARE MODELING OF 3D CONCRETE PRINTING STRENGTH VIA NEURAL STOCHASTIC DIFFERENTIAL EQUATIONS
Abdulmajid B. Umar, Fatima Ado Musa	ENHANCING STOCK PRICE PREDICTION WITH BI-DIRECTIONALLSTM-GREY WOLF OPTIMIZER (BILSTM-GWO)
Yasemin Demirel	OPTIMIZING SEQUENTIAL DATA PROJECTIONS VIA NONPARAMETRIC ERROR CORRECTION: A COMPOSITE MODELING APPROACH

15:30 - 15:45

Coffee Break

AUTHORS	TITLES
Güldar Efe, Erhan Pişkin	EXISTENCE OF SOLUTIONS FOR A HIGHER-ORDER WAVE EQUATION WITH DELAY TERM
Muhteşem Demir, Erhan Pişkin	THEORETICAL AND NUMERICAL RESULTS OF SOLUTIONS FOR THE PARABOLIC TYPE EQUATION
Erhan Pişkin, Nebi Yılmaz	THEORETICAL AND NUMERICAL ANALYSIS OF NONLINEAR HIGHER-ORDER WAVE EQUATIONS
Bülent Saka, Ömer Yazar	SOLUTION OF THE EW EQUATION USING THE MULTI-STEP QUINTIC B-SPLINE COLLOCATION METHOD

AUTHORS	TITLES
Nigar Yıldırım Aksoy, Nurşah Çelik	ON SOLUTION OF A NEUMANN PROBLEM FOR A SCHRODINGER-TYPE EQUATION
Merve Zeynep Kaya, Ercan Çelik, Mesut Karabacak	PHYSICS-INFORMED GRAPH NEURAL NETWORKS FOR SOLVING HEAT EQUATION PDES ON SCATTERED MESHES
Gülşen Orucova Büyüköz	BINARY NEWTON-RAPHSON BASED OPTIMIZER WITH S-SHAPED AND V-SHAPED TRANSFER FUNCTIONS FOR 0-1 KNAPSACK PROBLEM
Dmitrii Zhelobnev, Nisa Çelik	EXACT ANALYTICAL WAVE SOLUTIONS FOR THE COMBINED KAIRAT-II-X EQUATION VIA THE MODIFIED SARDAR SUB-EQUATION METHOD
Orhan Amirov, Mesut Karabacak	COMPARATIVE ANALYSIS OF COMBINATORIAL OPTIMIZATION PROBLEMS USING QUANTUM ANNEALING AND GROVER'S ALGORITHM
Nur Sultan Yüce, Mesut Karabacak	MACHINE LEARNING-ASSISTED PARAMETER OPTIMIZATION FOR DECOYSTATE BB84 QKD UNDER FINITE-KEY CONDITIONS

AUTHORS	TITLES
Zuhal Kucukarslan Yuzbasi	GEOMETRIC DYNAMICS OF SPIN CHAINS
Ahmed Kharmouche	STATIC AND DYNAMIC EXPERIMENTAL MEASUREMENTS OF CO THIN FILMS MAGNETOCRYSTALLINE ANISOTROPY CONSTANTS
Abubakar A. Sifawa	IMPACT OF GROWTH AND THERMAL ANNEALING IN OXYGEN AND NITROGEN ATMOSPHERES ON THE PROPERTIES OF TERBIUM OXIDE THIN FILMS FOR ADVANCED SEMICONDUCTOR APPLICATIONS
Alexander Kuzmin	TRANSONIC FLOW INSTABILITY OVER AIRFOILS AT SMALL DEPLOYMENTS OF A SPOILER
Sani I. Abba	WAVELET-BASED NONLINEAR DYNAMIC MODELING OF SEAWATER FRACTION IN COASTAL AQUIFERS

AUTHORS	TITLES
Hikmet Kemaloğlu, Baran Bahtiyar	NEURAL NETWORK PROCESS FOR MODEL OF INFECTIOUS DISEASE TRANSMISSION SYSTEM
Hikmet Kemaloğlu, Asaad Bakar	AN ARTIFICIAL DEEP NEURAL NETWORK APPROACH FOR MATHEMATICAL MODEL
Mansur Hassan, Mahmud Dalha Mahmud	AN EPQ MODEL FOR NON-INSTANTANEOUS DETERIORATING ITEMS WITH GRADUAL SUPPLY AND SHORTAGE UNDER TWO PHASE PRODUCTION RATE
Djamal Hamadi, Abdulrahman M. Al-Nadhari, Ali Zine, Maria Legouirah	NONLINEAR ANALYSIS OF ISOTOPIC PLATES WITH STRAIN-BASED FINITE ELEMENT AND COMPLEX BOUNDARY CONDITIONS
Huzaiifa Umar, Maryam Isa Abdulkadir, Maryam Rabiou Aliyu, Abubakar Adamu	ENHANCEMENT OF MALARIAL PARASITE IMAGE RESTORATION USING FISTA AND INERTIAL TSENG MATHEMATICAL ALGORITHMS
Farouk Sa'ad	OPTIMAL CONTROL AND MATHEMATICAL MODELING OF EBOLA VIRUS TRANSMISSION IN BAT-HUMAN INTERACTIONS

19:00 - 24:00

Dinner

Gala Dinner at the Nippon Hotel

Day 2: 25 April 2026

10:30 - 11:00

PLENARY LECTURE - Beykent University Taksim Campus Adem Çelik Auditorium

Speaker: PROF. DR. YELİZ KARACA

Title: MATHEMATICAL NEURON-NEURAL-NETWORKS DYNAMICS WITH CONTINUOUS- AND DISCRETE-TIME MODELS IN NEUROSCIENCE, BIOLOGY AND PRECISION MEDICINE: COMPLEX FEATURE ENGINEERING AND DATA COMPLEXITY

Chair: PROF. DR. ALMAS TEMBIRBEKOV

11:00 - 11:15

Coffee Break

AUTHORS	TITLES
Mehmet Ali Taşkıran, Tuğçem Partal	HYBRID AI-BASED MATHEMATICAL MODELING OF BREAST CANCER DYNAMICS
Gülsüm Şanal	FRACTIONAL LYAPUNOV STABILITY ANALYSIS AND STATISTICAL INFERENCE OF A FRACTIONAL STABILITY INDEX (FSI) FOR TIME-DYNAMIC RISK TRAJECTORIES
Ebru Altunbağ	MULTI-TASK TRANSFORMER ARCHITECTURE FOR MULTI-ASSET FINANCIAL RISK AND RETURN FORECASTING: CONDITIONAL EFFICACY, NEGATIVE TRANSFER, AND EXPLAINABILITY ANALYSIS
Esra Pekönür, Sevilay Erdoğan Tutam, Mutlu Akar	SARDAR METHOD FOR SOLITON SOLUTIONS IN ANTI-CUBIC NONLINEAR MODEL
Sevilay Erdoğan Tutam, Esra Pekönür, Mutlu Akar	EXACT SOLUTIONS OF FRACTIONAL BISWAS–MILOVIC EQUATION USING KUDRYASHOV METHODS
Şükran Yalçın	SYMMETRY METHODS FOR ORDINARY DIFFERENTIAL EQUATION
Dmitrii Zhelobnev, Nisa Çelik	EXACT ANALYTICAL WAVE SOLUTIONS FOR THE COMBINED KAIRAT-II-X EQUATION VIA THE MODIFIED SARDAR SUB-EQUATION METHOD

AUTHORS	TITLES
Mst. Munny Khatun, M. Ali Akbar, Onur Alp İlhan	ANALYSIS OF THE OPTICAL SOLITON SOLUTIONS TO THE FRACTIONAL CUBIC-QUARTIC NONLINEAR SCHRODINGER EQUATION WITH PARABOLIC-LAW
Duygu Dönmez Demir, Asuman Açıık, Ali Konuralp	THE PELL-LUCAS COLLOCATION METHOD FOR HIGH-ORDER LINEAR DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS
Dorsaf Kouas	ON THE S-SPECTRUM AND LOCAL S-SPECTRUM OF QUATERNIONIC RIGHT LINEAR OPERATORS
Sana Bouzidi	CHARACTERIZATION OF SOME ESSENTIAL SPECTRA OF THE SUM OF TWO BLOCKS OPERATOR MATRICES INVOLVING THE RELATIVELY FREDHOLM PERTURBATIONS
Surajo Sulaiman, Aliyu Suleiman	GENERALIZED ENTRY FORMULA FOR COMPUTING A MULTIVARIATE POLYNOMIAL RESULTANT
Emre Arslan	A DETAILED ANALYSIS OF THE COLLATZ CONJECTURE

AUTHORS	TITLES
Semih Geçen, İlhan İçen, A. Fatih Özcan	UNCERTAINTLY MANAGEMENT IN ARTIFICIAL INTELLIGENCE: SOFT SET THEORY AND APPLICATION AREAS
Sevda Ö. Çalığışu, Davood Ahmadian, Fevzi Erdoğan, Nihal İnce, Vildan Aslan	MODELING INVESTOR PHYSIOLOGY WITH STOCHASTIC DYNAMICS: FROM EMOTIONAL PARAMETERS TO BEHAVIORAL CLUSTERS
Araz R. Aliev, Rustam Eyniyev	IMPROVING THE INTELLIGENCE OF NON-PLAYER CHARACTER IN GAMES USING MACHINE LEARNING AND DEEP LEARNING METHODS FOR TEXT-BASED DEPRESSION DETECTION
Faton Merovci	STATISTICAL PROPERTIES AND APPLCATIONS OF A NEW TWO-PARAMETER INVERSE RAYLEIGH DISTRIBUTION
Mehmet Mustafa Beydağı, Abdullah Fatih Özcan, İlhan İçen	ROUGH SET THEORY IN MULTI-CRITERIA DECISION MAKING
Dilara Altan Koç, Özlem Kırcı, Melik Şenyuva, Hasan Bulut	EXACT RATIONAL-EXPONENTIAL TRAVELING WAVE SOLUTIONS OF THE POCHHAMMER–CHREE EQUATION WITH COMPLEX AMPLITUDE STRUCTURES
Özge Hamzaoğlu, Arzu Akbulut	EXACT SOLUTIONS OF THE EXTENDED KAIRAT II-X EQUATION

AUTHORS	TITLES
Fahrettin Yakuphanoglu	BEYOND THE INTEGER-ORDER REALITY: FRACTAL TIME-DYNAMICS OF SEMICONDUCTORS ENCODED VIA FYTRONIX HARDWARE-IN-THELOOP (HIL) MODELING
Fahrettin Yakuphanoglu	RECURSIVE SINGULARITY MAPPING: A DIVERGENT NUMERICAL PARADIGM FOR SYNCHRONOUS SIGNAL EVOLUTION IN SUBDECAMETRIC DEFENCE ELECTRONICS
Fahrettin Yakuphanoglu	NONLINEAR STOCHASTIC MAPPING AND ATTRACTOR STABILIZATION IN FYTRONIX NANOSTRUCTURED SOLAR SIMULATION SYSTEMS
Aysegul Dere	THE MEMORY OF MATTER: A FRACTIONAL ONTOGENY OF BIO-ORGANIC SENSING INTERFACES
Aysegul Dere	BEYOND LINEAR APPROXIMATION: MULTIPHYSICS NUMERICAL ARCHITECTURES FOR CAPTURING NON-EQUILIBRIUM OPTOELECTRONIC FLUX IN DISORDERED THINFILM TRANSISTORS
Şeyma Firdevs Hızal, Özlem Defterli, Hasan Bulut	AN OVERVIEW OF RECENT MATHEMATICAL MODELS TO PREDICT EPIDEMICS

12:45 - 14:00

Lunch

Beykent University Law Faculty Restaurant

AUTHORS	TITLES
Ban Jamal Khalid Alsindi, Arif Özkul, Hasan Bulut	SOLITARY WAVE SOLUTIONS AND MODULATION INSTABILITY OF THE SCHRODINGER EQUATION WITH MIXED DERIVATIVE AND AMPLITUDE DEPENDENT TERM
Latifa Agamalieva, Ban Jamal Khalid Alsindi, Hasan Bulut	SOLITON SOLUTIONS OF THE LONGITUDINAL WAVE EQUATION IN A MAGNETO-ELECTRO-ELASTIC CIRCULAR ROD VIA KUDRYASHOV EXPANSION METHOD
Esin İlhan	AN EXTRACTION OF A NOVEL SOLITON SOLUTIONS OF THE NONLINEAR MATHEMATICAL MODEL
Esin İlhan	ANALYTICAL STRUCTURES AND CONSERVATION LAWS OF THE (2+1)-DIMENSIONAL CUBIC KLEIN-GORDON EQUATION
Tukur Abdulkadir Sulaiman, Hanife Kalka, Mehtap Guneri, Hasan Bulut	NEW WAVE STRUCTURES OF A NONLINEAR PHYSICAL MODEL
Şeyma Firdevs Hızal, Mehtap Güneri, Hasan Bulut	NOVEL SOLITONS OF THE BISWAS - MILOVIC EQUATION WITH KERR LAW NONLINEARITY
Betül Özbay Elibüyük	DYNAMICS OF ADVECTION-DIFFUSION-REACTION PROCESSES: A Z^+ -NUMBER VALUED APPROACH WITH ABC GRANULAR FRACTIONAL CALCULUS
Aynur Şahin	ON A FASTER ITERATIVE METHOD FOR FIXED POINT PROBLEMS IN BANACH SPACES AND ITS APPLICATIONS

AUTHORS	TITLES
Hasan Bulut, Yaren Kılıç, Şeyma Firdevs Hizal	APPLICATIONS OF THE (M+1/G') METHOD TO SOME NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS
Hasan Bulut, Şeyma Firdevs Hizal, Gülnur Yel	TYPE-SOLITONS PROPAGATION FOR NONLINEAR SYSTEMS OF MATHEMATICAL MODEL
Melik Senyuva, Ban Jamal Khalid Alsindi, Hasan Bulut	WAVE PROPAGATION OF THE (2+1)-DIMENSIONAL NON- LINEAR SCHRODINGER EQUATION
Arif Ozkul, Oznur Engin, Hasan Bulut	THE EXTENDED RATIONAL SINE-COSINE AND SINH-COSH METHODS APPLIED TO THE NONLINEAR COMPLEX SYSTEMS
Ayse Nur Akkılıc, Zulqurnain Sabir, Hasan Bulut	A NUMERICAL STOCHASTIC COMPUTING PERFORMANCES FOR THE IMMUNE REGULATION OF TYPE 1 DIABETES
Hakan Faik Er, Halit Orhan	RELATIONSHIP BETWEEN UNIVALENT FUNCTIONS AND FRACTAL GEOMETRY

14:15 - 15:45 | Poster Session

AUTHORS	TITLES
Gazmend Nafezi, Eros Halili, Mazllum Kamberi	MONTE CARLO-BASED NUMERICAL VERIFICATION OF CLINICAL ELECTRON BEAM DOSIMETRY USING FLUKA
Zurki Ibrahim	COMPARATIVE PERFORMANCE OF MACHINE LEARNING MODELS IN AFRICAN REGIONS WITH HIGH AND LOW COVID-19 CASE PREVALENCE
Mazllum Kamberi	PREDICTIVE MODELING OF CONCRETE SHRINKAGE USING SOFT COMPUTING METHODS: GRNN, RBF NEURAL NETWORKS, AND SVM
Aysegul Dere	SCULPTING THEVOID: THE TOPOLOGICAL NARRATIVE AND FRACTAL SOVEREIGNTY OF VACUUM-GROWN ATOMIC LANDSCAPES

15:45 - 16:00

Coffee Break

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