THIRD INTERNATIONAL
BILATERAL WORKSHOP ON
NATURAL SCIENCE BETWEEN
DOKUZ EYLUL UNIVERSITY AND
AZERBAIJAN NATIONAL ACADEMY OF SCIENCES

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ABSTRACT BOOK

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Contents

BIOLOGY SESSION

CHEMISTRY SESSION

Contents

COMPUTER SCIENCES SESSION

MATHEMATICS SESSION

STATISTICS SESSION

Contents

PHYSICS SESSION

SCIENTIFIC PROGRAMME

OPENING SPEECHES

09:45–10:00   Aylin ALIN, Dean (DEU)
İrada HUSEYNOVA, Vice President (AMEA)
İsa HABIBBEYLI, President (AMEA)
Bayram YILMAZ, Rector (DEÜ)

STATISTICS SESSION
10:00–11:20
Moderator: Barış Tekin TEZEL (DEU)

10:00–10:20
"Generalized entropy optimization methods (GEOM`s) in theory of stochastic differential equations"
Aladdin SHAMILOV, Natiq QULIYEV

10:20–10:40
"Weighted Robust Regression Forest"
Aylin ALIN

10:40–11:00
"Statistical methods for metal coordination analysis in structural biology"
Kaveh BABAI, Fei LONG, Martin MALÝ, Keitaro YAMASHITA, Garib MURSHUDOV

11:00–11:20
"ATA Forecasting Method"
Güçkan YAPAR

TIME BREAK, 11:20– 11:40

COMPUTER SCIENCES SESSION
11:40–13:20
Moderator: Barış Tekin TEZEL (DEU)

11:40–12:00
"The tracking algorithm of the object selected on the image of the video camera"
Ali ABBASOV, Adalat PASHAYEV, Sadiq MALIKOV, Elkhan SABZIEV

12:00–12:20
"A Model Ensemble Approach for Detection and Classification of Peacock Eye Disease in Olive Plants"
Cengiz Mehmet ALBOYACI, Can ATILGAN

MATHEMATICS SESSION
10:00–11:00
Moderator: Ümit DOĞAN (DEU)

10:00–10:20
"Numerical Solutions of Highly Sensitive Troesch's Problem"
Meltem ADIYAMAN

10:20–10:40
"Quadratic functional in the problem of the calculus of variations with one fixed end point"
Narmina GUBATOVA

10:40–11:00
"F-supplemented modules"
Salahattin ÖZDEMİR

TIME BREAK, 11:00– 11:40

PHYSICS SESSION
11:40–13:20
Moderator: Elchin JAFAROV (AMEA)

11:40–12:00
"Phase space to the q-deformed quantum oscillator as a tool for description of the bluffing phenomenon in the untrusted supply–demand relationship"
Elchin JAFAROV

12:00–12:20
"Biological Activity Investigations of Malvidin and It's Glucosides by using DFT and Molecular Docking Studies"
Duygu Barut CELEPCİ

12:20–12:40
"Application of group decision-making in a multi-method pattern recognition system"
Kamil AIDA-ZADE, Rustam AZIMOV

12:40–13:00
"Investigating the possibility of providing more ecologically efficient proposals for the transport sector in our country"
Kamran MUSTAFAYEV

13:00–13:20
"Quantum Safe Passwordless Authentication"
Barış GÜLEK, Koray AKPINAR, Mehmet Mert KÜTÜK, Erdem ALKIM

12:20–12:40
"Evaluation of the water quality and its suitability for drinking and agricultural use in Gubadli district of Azerbaijan"
Famil HUMBATOV, Qeys IBRAHIMOV, Valeh BALAYEV, Gultakin ASLANOVA, Nisa KARIMOVA, Intizar KARIMBAYLI

12:40–13:00
"Elimination of interference affecting analytical signals of ICP-MS"
Tarana NURUBEYLI, Nurlana JAFAR

13:00–13:20
"Artificial Neural Network Approach to Spin Models"
Ümit AKINCI

LUNCH BREAK, 13:20– 14:40

BIOLOGY SESSION
14:40–16:40
Moderator: Barış Tekin TEZEL (DEU)

14:40–15:00
"Desertification as a factor of climate changes"
Tubukhanim GASIMZADE

15:00–15:20
"New insights on goblet cell differentiation in colorectal cancer"
Gulnar ABDULLAYEVA, Irada HUSEYNOVA, Walter BODMER

15:20–15:40
"Diet composition of lacertid lizards: is cranial shape important?"
Elif YILDIRIM, Eda ŞEN, Ahmet Gökay KORKMAZ, Ecem Büşra HASTÜRK, Yusuf KUMLUTAŞ, Çetin ILGAZ, Kamil CANDAN

15:40–16:00
"Biochemical and ultrastructural characteristics of Zea mays L. under salt stress"
Nahida ALIYEVA, Durna ALIYEVA, Saftar SULEYMANOV, Irada HUSEYNOVA

CHEMISTRY SESSION
14:40–16:40
Moderator: Ümit DOĞAN (DEU)

14:40–15:00
"Hydrogen production by direct catalytic pyrolysis of natural gas"
Etibar ISMAILOV, Dilgam TAGIYEV

15:00–15:20
"CU(II) Removal from Aqueous Solution using Formazan Functionalized Silica "
H.Mine ANTEP, Yıldız ÇELTİK, Cevher GÜNDOĞDU HIZLIATEŞ, M.Nalan DEMİR

15:20–15:40
"Synthesis and study of polymer-based enterosorbents: removal of heavy metals"
Sevda FATULLAYEVA, Nizami ZEYNALOV, Shamil TAGIYEV, Aytan GULIYEVA, Rena SULEYMANOVA, Lala GULUBAYOVA

15:40–16:00
"Study of the pyrolysis process of plastic waste by TGA, IR and GC methods"
Muslim GURBANOV, Ulviya GULIYEVA, Elshan MIRZAZADE

16:00–16:20
"Social interactions of viruses"
Ergin ŞAHİN

16:20–16:40
"The role of rodents in the distribution of the opportunistic human pathogens Coccidia"
Turkan GURBANOVA

16:00–16:20
"Antifouling Performance Test of Polysaccharide Ulvan from Ulva lactuca (L.) off the İzmir Coastline"
Sema DOĞMAZ, Levent ÇAVAŞ

16:20–16:40
"Antibacterial evaluation of stearic acid-derived molecules for water purification: a case study on Caspian seashore near Sumgait"
Vagif ABBASOV, Durna AGHAMALIYEVA, Zaur AGHAMALIYEV, Emil AYDINSOY, Nihat ALIMADATLI

CLOSING SESSION, 16:40–17:00

Workshop Group Photo (Online)

BIOLOGY SESSION

New insights on goblet cell differentiation in colorectal cancer

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Uncontrolled cell proliferation and impaired differentiation constitute a major driving force in cancer progression. In colorectal cancer (CRC), deregulation of cell differentiation is reflected by the reduced prevalence of goblet cells, which play a critical role in the maintenance of the mucosal barrier within the intestine. In this study, we evaluated a large panel of CRC-derived cell lines based on both mRNA and protein levels of MUC2 (the primary mucous component of goblet cells) and TFF3 (an associated gene product). Five distinct expression patterns of MUC2 and TFF3 were identified in CRC cell lines and human colon cancer tissue sections, which enable a finer classification of CRCs in terms of goblet cell differentiation. Interestingly, about 30% of CRC cell lines exhibited TFF3 expression without MUC2, indicating a novel subgroup that had not been previously described. In addition, several transcription factors linked to goblet cell differentiation, including ATOH1, SPDEF, CDX1, and CDX2, were investigated, with ATOH1 showing a stronger effect compared to the others. However, on its own, it was not sufficient to induce MUC2 and TFF3 expression in entirely negative CRC cell lines. Our results provide key insights into targeting specific subsets and understanding regulatory mechanisms involved in goblet cell differentiation, which emphasise the potential for improved diagnostic and therapeutic approaches in CRC.

Keywords: Cell differentiation, MUC2, TFF3, transcription factors, colorectal cancer.

Diet composition of lacertid lizards: is cranial shape important?

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Lizards play a crucial role in almost every terrestrial ecosystem and exhibit considerable ecological diversity. However, there is a notable scarcity of data regarding their ecomorphology. Most studies of lacertid skull features in relation to diet have relied on linear measurements. This study uses geometric morphometrics to explore how cranial shape correlates with the diets of three lacertid species: Lacerta media , L. pamphylica, and L. diplochondrodes. For this purpose, 15 lateral, 20 dorsal, and 12 ventral landmarks in L. pamphylica (n=5), L. diplochondrodes (n=10), and L. media (n=10) were analyzed using geometric morphometrics. According to the analysis results, significant sexual dimorphism in cranial shape was found only in L. pamphylica, and the analysis distinguished the dorsal, ventral, and lateral skull shapes of L. media from those of L. diplochondrodes. Moreover, the stomach contents of the three lacertid species were analyzed to determine prey preferences. A total of 12 prey categories were detected. For L. diplochondrodes, the most preferred prey types were Coleoptera and Diptera; however, gastropod prey was found only in this species. The data indicate that L. pamphylica primarily feeds on Araneae, Hymenoptera and plant items, while in L. media, the most frequently consumed prey items were Coleoptera, Araneae and Orthoptera. The hardness and evasiveness of the prey were also analyzed. Among the three examined lacertid species, the most remarkable finding is that cannibalism behavior has been observed for the first time only in L. media. This is the first instance in which our knowledge of geometric morphometric comparisons of the skulls in these lacertids has enabled inferences about ecological preferences in diet based on cranial shape.

Keywords: Lacertidae, diet composition, cranial morphology, cannibalism.

Biochemical and ultrastructural characteristics of Zea mays L. under salt stress

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The world has experienced an abrupt change in climate over the last two decades. It is clear that both natural and artificial factors are drivers of climate change. These factors have unequivocally altered the pattern of precipitation, leading to a notable rise in sea levels, changes in evapotranspiration, the occurrence of flood overwintering of pathogens, increased resistance of pests and parasites, and a reduction in plant productivity. While excess CO_2 encourages the growth of C3 plants, high temperatures reduce the yield of crucial agricultural crops due to high evapotranspiration. These two factors impact soil salinization and agricultural production, creating a challenge for water and food security. Plants with C4 photosynthesis are characterized by a high efficiency of CO^2 assimilation and highly specialized photosynthetic apparatus. However, the structural and functional changes caused by stress in the chloroplasts of M and BS cells of C4 plants have not been sufficiently studied. The goal of the study was to compare the biochemical properties and ultrastructure of the mesophyll and bundle sheath cell chloroplasts of the maize (Zea mays L.) under salt stress. It was found out that high salinity induced a number of functional and structural changes in the chloroplasts of maize plants. At elevated salt concentrations, the F735/F686 nm fluorescence ratio was decreased in M chloroplasts, whereas it was enhanced in BS chloroplasts. The photochemical activity of PSII was found to be reduced in both chloroplast types. The analysis of the protein content of the thylakoid membranes of M and BS chloroplasts revealed the presence of polypeptides belonging to the core antenna of PSII (47 kDa and 43 kDa) and LHCII (28-24 kDa) in both types of membranes. However, their intensity was found to be weak in BS thylakoids. At the same time salt stress had a greater impact on the ultrastructure of M chloroplasts than on BS ones, resulting in the formation of granal stacking in BS chloroplasts. These results may indicate that the two chloroplast types exhibit different responses to salt stress.

Keywords: Zea mays L., salt stress, C3 and C4 photosynthesis, mesophyll and bundle sheath chloroplasts.

Desertification as a factor of climate changes

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Desertification is the degradation of soils in arid, semi-arid and rainless regions of the globe, caused by both anthropogenic influences and natural factors and processes The concept of "soil" in this case means a bioproductive system consisting of soil, water, vegetation, other biomass, as well as ecological and hydrological processes within the systems. The most vulnerable areas include regions with arid, subarid and dry climate conditions, which are very sensitive to climate change. Soils become eroded and saline, lose their ability to retain moisture, groundwater levels drop, vegetation decreases or disappears altogether. The object of our research is the soil and vegetation cover of the Shirvan region of Azerbaijan - the food base of the republic, distinguished by a large number of summer and winter pastures. Problems of desertification have arisen as a result of unsystematic and excessive grazing of livestock, the loss of most of the vegetation, soil degradation, and in some places also intensive farming in the flat areas of Shirvan regions. The species composition of the associations Suaeda mycrophylloso – Petrosimonia brachiatosum; Salicornia europeoso - Suaeda confusosum; Petrosimonia brachiatoso – Climacoptera crassosum; Climacoptera crassoso – Petrosimonia brachiatosum; Salsola nodulososo – Ephemeretosum; Salsoleta dendroideso – Ephemeretosum; Salsoleta dendroideso – Alhagi pseudalhagiosum have been established. Desert plant type of the Shirvan territory is of a zonal nature and is formed by 2 formational classes, 6 formations and 19 associations was revealed in results of the research.

Keywords: Desertification, climate change, soil-vegetation cover, arid territories.

Social interactions of viruses

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Recent research has revealed a complex social world among viruses, marked by cheating, cooperation, and other interactions, indicating that viruses are best understood as part of a community. Understanding the messages exchanged by viruses could greatly benefit human health.

Keywords: Sociovirology, viral cheating, viral cooperation.

The role of rodents in the distribution of the opportunistic human pathogens Coccidia

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The investigation of the coccidian fauna of 320 murine rodents of 11 species from urban ecosystems of Azerbaijan was conducted. Along with rodents, we also investigated 84 Isabelline wheatears, birds from the order of Passeriformes, which lived in the burrows of red-tailed gerbil. Cryptosporidium oocysts were found in the feces isolates of 90 rodents (28.1%) of 7 species, and Eimeria oocysts were found in 89 rodents (27.8%.) of 4 species. Oocysts of Cryptosporidium and Isospora were isolated in 16 (19.05%) and 15 (17.9%) birds respectively.

It was established that in urban ecosystems synanthropic rodents (brown rat, house mouse) and red-tailed gerbil, which is prone to synanthropism, are involved in the circulation of opportunistic protozoan pathogen cryptosporidium along with farm animals and humans.

For the first time it was established that red-tailed gerbil and house mouse are natural hosts of Cryptosporidium and Isospora, respectively. We also discovered two previously unknown species Eimeria sp.1 and sp. 2 in brown rats and oocysts of E. jerfinica in field mice (Apodemus agrarius Pall.). Previously, it was found that E. jerfinica Musaev et Veisov, 1963 is common for wood mouse (Apodemus sylvaticus L.). We conclude that E. jerfinica is a polyxenic species.
For the first time in Azerbaijan, molecular methods including DNA extraction, PCR and sequencing were used for the study of Eimeria in 39 red-tailed gerbils, 3 brown rats and 1 house mouse. Phylogenetic trees of Eimeria based on the COI and SSU gene sequences were constructed.

The number of infected female red-tailed gerbils was higher than of infected males. The sex of synanthropic rodents did not affect the level of infestation with Cryptosporidium. The number of young individuals of synanthropic rodents and red-tailed gerbil infected with Cryptosporidium was greater than of infected adult individuals of the same species.

CHEMISTRY SESSION

Hydrogen production by direct catalytic pyrolysis of natural gas

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The global community is actively switching to renewable and alternative energy sources, aiming to reduce greenhouse gas emissions (CO_2, NO_x, SO_x) by 60% by 2050. In this context, hydrogen is seen as a promising energy source capable of reducing the environmental impact. Although hydrogen can be produced from various sources, it is important that the production and consumption cycle avoids new carbon emissions. This trend requires the development of low-carbon technologies for hydrogen production. Currently, the most common industrial method for producing hydrogen is steam methane reforming, which, however, generates significant CO_2 emissions. Methane pyrolysis is a cleaner alternative, producing hydrogen and solid carbon without CO_2 emissions. This paper presents the results of studies of iron, cobalt and nickel based catalysts in catalytic pyrolysis of methane using scanning electron microscopy combined with energy dispersive elemental analysis, X-ray photoelectron spectroscopy, X-ray diffractometry, Raman and Fourier transform infrared spectroscopy, electron magnetic resonance combined with mass spectrometry of gas-phase reaction products, the effect of pyrolysis conditions on the phase composition and distribution of active components in the catalyst structure, their charge composition. The results emphasize the importance of periodic monitoring of the catalyst composition and structure under operating conditions, which allows for early adjustments to maintain and optimize catalyst performance. Solvothermal synthesis of multicomponent catalysts for methane pyrolysis based on cyclopentadienyl compounds of iron, cobalt, nickel, titanium, zirconium and lanthanum in equimolar concentrations of their main components was carried out and it was shown that the highly defective crystal lattice and amorphous structure create the basis for increasing the catalytic activity in the reaction of methane pyrolysis into hydrogen and nanocarbon material. The results of this reaction, important from theoretical, practical and environmental points of view, can be used in the creation and study of multicomponent catalysts consisting of high-entropy phases.

Keywords: Hydrogen production, natural gas, methane, catalytic pyrolysis.

CU(II) Removal from Aqueous Solution using Formazan Functionalızed Silica

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Formazans are a significant and unique class of nitrogen-rich organic compounds with an NH-N=C-N=N backbone. One of the fields of research in formazan chemistry is creating materials with predefined properties using formazan immobilization onto different matrices, such as cellulose, organic resin, or silica gel. These substances may be useful for modifying silica gels and ion exchangers using sorption-spectroscopic and chromatographic analytical methods as well as heterogeneous catalysis.

Silica was modified with 5 - (3 - silicapropylcarbamoyl - 5 - (2 - isonicothionoylhydrazano) (9 - methyl - 9H - carbazole -3-ylmethyl)diazenyl) phenyl)-1-isonicotinoyl-3-(9-methyl-9H-carbazole-3-yl)formazan synthesized in our laboratory. The FT-IR, XRD, and SEM data were used to identify and clarify the structure of the novel sorbent. Additionally, factors such as temperature, contact time, pH, concentration, amount of composite were examined ito evaluate the effect on the adsorption capacity. Desorption of the adsorbed ions and composite reusability were also studied. Maximum adsorption capacity of the formazan modified silica was determined as 34 mg/g at pH 6.0. In addition, kinetic models (pseudo-second-order and pseudo-first-order), adsorption isotherms (Freundlich and Langmuir), and thermodynamic parameters (entropy, Gibbs free energy, and enthalpy) were examined. Adsorbed Cu(II) was desorbed by more than 90% with 0.1 M HCl. It is thought that 5-(3-silicapropylcarbamoyl - 5 - (2 - isonicothionoylhydrazano) (9 - methyl - 9H - carbazole - 3 - ylmethyl) diazenyl) phenyl) - 1 - isonicotinoyl - 3 - (9 - methyl -9H-carbazole-3-yl)formazan modified silica would be a promising adsorbent for the treatment of l heavy metal from wastewater.

<u>Keywords</u>: Formazan, removal, waste water.

Synthesis and study of polymer-based enterosorbents: removal of heavy metals

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Environmental pollution is one of the most important problems of modern society. Production and use of a huge amount of toxic substances in various fields of industries lead to ozone depletion, emissions of greenhouse gases, the formation of acid rain, the death of flora and fauna, and an increase in natural disasters, which have dire consequences for living organisms. Heavy metals are considered persistent environmental pollutants. Despite the fact that heavy metals are necessary in certain quantities for the normal functioning, they can be dangerous at accumulating in the organism (in excess concentrations the metal ion passes into the category of toxic substances), resulting in appearance of pathological processes and certain diseases. To prevent serious risks to human health, eliminating the toxicity of these metals in air, soil, and water is of great importance. Minimization and removal of excessive amount of heavy metal ions from the organism is an important area of modern research. Literature data have shown the high efficiency of efferent therapy methods in the field of detoxification of the organism, including enterosorption as a method of binding and excreting of toxic substances from the organism. Enterosorbents, having a certain sorption capacity, are not destroyed in the gastrointestinal tract, and must be non-toxic, biocompatible with tissues, have not a traumatic effect on tissues and mucous membranes, etc. With all the variety of enterosorbents, substances based on natural molecules are of particular interest. The purpose of this research is the synthesis and study of effective enterosorbents based on polymers having sorption activity toward heavy metal ions and pharmacological properties. Polymers, which include chitosan, poly-N-vinylpyrrolidone and their derivatives, are the most promising group of substances. The structures of samples were studied using FTIR, XRD, SEM, and thermal analyses.

Keywords: Synthesis, polymer, enterosorbent, heavy metal, toxicity.

Study of the pyrolysis process of plastic waste by TGA, IR and GC methods

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The rapid growth of plastic waste poses serious environmental risks to the environment. The study of plastic waste in the field of various processing and use is relevant as ecological and alternative fuel sources. In this study, the chemical changes occurring during the pyrolysis of various plastic wastes used as packaging materials (PET, PP, PS) were studied by TGA, IR and GC methods. The thermal (Superior Heat Value, MJ/m^3) parameters of the gas mixture formed during the vacuum pyrolysis process at temperatures of 350, 450 and 550 0C and the amount of gas products were determined. Thermal parameters are 42.14, 51.11 and 52.25 MJ/m^3 for PET 1, PP5 and PS6 plastic waste, respectively. The volume of the gas mixture varies in the range of 15-20% at a temperature 550 0C. Activation energy and thermodynamic parameters of pyrolysis process were determined. The chemical changes occurring during the thermal process were monitored in the IR spectra and the spectral composition of the solid residues with the temperature increasing was studied.

Keywords: Thermal pyrolysis, activation energy, product yield, thermal and thermodynamic parameters.

Antifouling Performance Test of Polysaccharide Ulvan from *Ulva lactuca* (L.) off the İzmir Coastline

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Biofouling refers to the undesirable accumulation of micro- and macro-organisms on surfaces with which they come into contact. These organisms leads to significant issues in various industries, including filtration systems, power plants, aquaculture cages, and ship transportation. When marine organisms accumulate on surfaces submerged in seawater, it is specifically called marine biofouling. Antifouling encompasses the efforts aimed at preventing the accumulation of marine organisms on these surfaces. Antifouling technologies are employed to address biofouling challenges in marine industries. *Ulva lactuca* is one of the marine seaweeds in the İzmir bay. Ulvan, a polysaccharide in *U.lactuca*, was isolated. In this research, the antifouling performance of ulvan was tested in İzmir bay between August and October-2024 within a model self-polishing antifouling paint. The results showed that ulvan included antifouling paints significantly reduced the barnacle attachments compared to the control plates. All paints coated with antifouling paint were covered with a microfilm layer. Among the organisms attached to the test plates, barnacles (*Balanus amphitrite*) and sepulids (*Hydroides elegans*) were dominant. The best antifouling performance was observed in the antifouling paint sample containing 1% ulvan. In conclusion, ulvan with modifications based on in silico technology can give better antifouling performances and contribute to development of eco-friendly antifouling paints.

Keywords: *Ulva lactuca*, Ulvan, polysaccharide, antifouling, fouling.

Antibacterial evaluation of stearic acid–derived molecules for water purification: a case study on Caspian seashore near Sumgait

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This study evaluates the antibacterial properties of novel molecules synthesised from stearic acid against coliform, E. coli, and Enterococcus bacteria in contaminated seawater near Sumgait. Molecules E-1, E-2, E-3, and E-5, synthesised through the reaction of stearic acid with monoethanolamine, diethanolamine, triethanolamine, and diethanoltriamine (DETA), respectively, were tested for their efficacy. The presence of those bacteria signals potential health risks, highlighting the need for effective antimicrobial treatments. Experimental results indicate significant bacterial reductions, with E-1 showing complete inhibition for certain bacteria. Docking analyses using AutoDock Vina provided insights into molecular interactions between E-1 and bacterial targets, explaining its superior efficacy. This study contributes to the development of effective stearic acid-based antimicrobial agents for water purification applications. The ability of these molecules to disrupt bacterial cell membranes, as indicated by their amphiphilic nature and interaction profiles, underscores their potential utility in addressing waterborne health risks. Exploring the long-term stability, impact on non-target microorganisms, and adaptability of these compounds in diverse environmental conditions will be essential for developing sustainable water treatment solutions based on stearic acid derivatives.

Keywords: Antimicrobial activity, stearic acid, molecular docking, water treatment applications.

COMPUTER SCIENCES SESSION

Application of group decision-making in a multi-method pattern recognition system

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Pattern recognition systems have many use cases in industry, business processes, and government institutions. Pattern recognition systems rely on mathematical models and methods. The recognition efficiency and reliability indicators of models using different recognition methods (Artificial Neural Networks, Support Vector Machine, Decision Tree, etc.), different object features and having different characteristics can be different for different pattern samples. Therefore, computer recognition systems consist of several subsystems that use separate modules and methods. This requires the use of group decision-making approaches, where different models are usually considered as experts in pattern recognition systems.

In the study, various group decision-making approaches were analyzed on the example of a computer system consisting of several subsystems that recognize the authorship of texts in the Azerbaijani language. A subsystem was added to the computer system on which this analysis was carried out, which makes the final decision about each recognized object.

Keywords: Group decision-making, authorship attribution, machine learning.

Quantum Safe Passwordless Authentication

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The FIDO2 is a standard protocol for passwordless online authentication. The client to authenticator protocol version 2.1 (CTAP2.1) of FIDO2 becomes more suitable to post-quantum secure protocols, since it requires only symmetric primitives, a key encapsulation mechanism (KEM) and a digital signature scheme. Although there are number of studies about the use of newly standardized post-quantum secure protocols in FIDO2. Both standards are still in development. In this work, we will report the current state of the research and possible directions for quantum-safe passwordless authentication.

The tracking algorithm of the object selected on the image of the video camera

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Intensive development of mechatronics systems allows automation of the process of observation and tracking of objects using video camera images. This type of work involves recognizing objects in images, selecting priority points (objects), calculating their movement indicators, and if necessary, pointing the video camera at a constantly moving object.

Depending on the purpose, different approaches and technologies can be used to track objects. This research paper presents an algorithm for automatically tracking a selected object on a screen image obtained from a video camera. An object is a part of an image limited by a certain rectangle, the centre of which is at a selected point in the image. This algorithm does not require a priori information about the tracked object. It is based on assessing the degree of closeness of the histogram calculated using the rectangle localizing the object in the image to the histogram calculated for new frames.

The Hausdorff metric was used to assess the closeness of the histograms. Computer experiments show that in some cases the proposed algorithm gives better results with a non-uniform background of the environment in which the tracked object moves.

Keywords: Object tracking, video image, tracking algorithm, histogram, Hausdorff metric.

A Model Ensemble Approach for Detection and Classification of Peacock Eye Disease in Olive Plants

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The global demand for food is escalating rapidly. However, climate change and global pandemics pose significant threats to food security. Addressing such challenges in agricultural areas has become more crucial than ever. Over the past decade, with advancements in image processing practices, numerous studies have been published with the aim of enhancing crop yield in agriculture through various methods, including plant disease and classification. Although the predictive accuracy of these models often approaches near-perfect results in scientific studies, achieving similar accuracy in practical applications remains challenging. This discrepancy primarily arises because many publicly available datasets, such as PlantVillage and PlantDoc, that serve as the basis for research do not fully capture the complexity, such as under different light conditions, and complex backgrounds of agricultural environments. In this study, we propose a model ensemble solution for the accurate identification and classification of peacock eye disease of olive plants using field images. The approach we propose leverages the Segment Anything Model to accurately outline all detectable objects within the image. Image processing techniques are subsequently employed to isolate these objects from the background. Using Fully Convolutional Data Description, a transparent deep one-class classification model, background objects are distinguished from actual leaf objects to detect anomalies. The segmented leaves are analyzed using a trained benchmark dataset classification model. This approach allows our model to identify diseases on individual leaves within the same image.

Investigating the possibility of providing more ecologically efficient proposals for the transport sector in our country

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In order to establish a development strategy deemed relevant and necessary in the thesis, it is imperative to update specialized software based on modern and efficient management principles to implement a network system. Similar to various developed countries, Azerbaijan requires the establishment of high-level management centres and the application of advanced technologies in its railway network, leading to the creation of electronic centres. This study discusses the formulation of significant and prospective development methods via railway transportation and the exploration of environmentally more efficient proposals in our country's transport sector. It also addresses the extraction of carbon dioxide from the atmosphere trough human activities, emphasizing the development of environmentally sustainable solutions for reducing CO_2 emissions. The main objective of the project is to examine the application of new and innovative technological capabilities in automating freight and passenger transportation by railway, with a focus on mapping intersection schemes of railway lines in various regions of Azerbaijan. Additionally, the project aims to explore various options for extracting carbon dioxide from the atmosphere due to human activities and to develop environmentally efficient proposals in the transport sector.

Keywords: Railway network, railway transport, prospective development, carbon dioxide, human activities, transport sector.
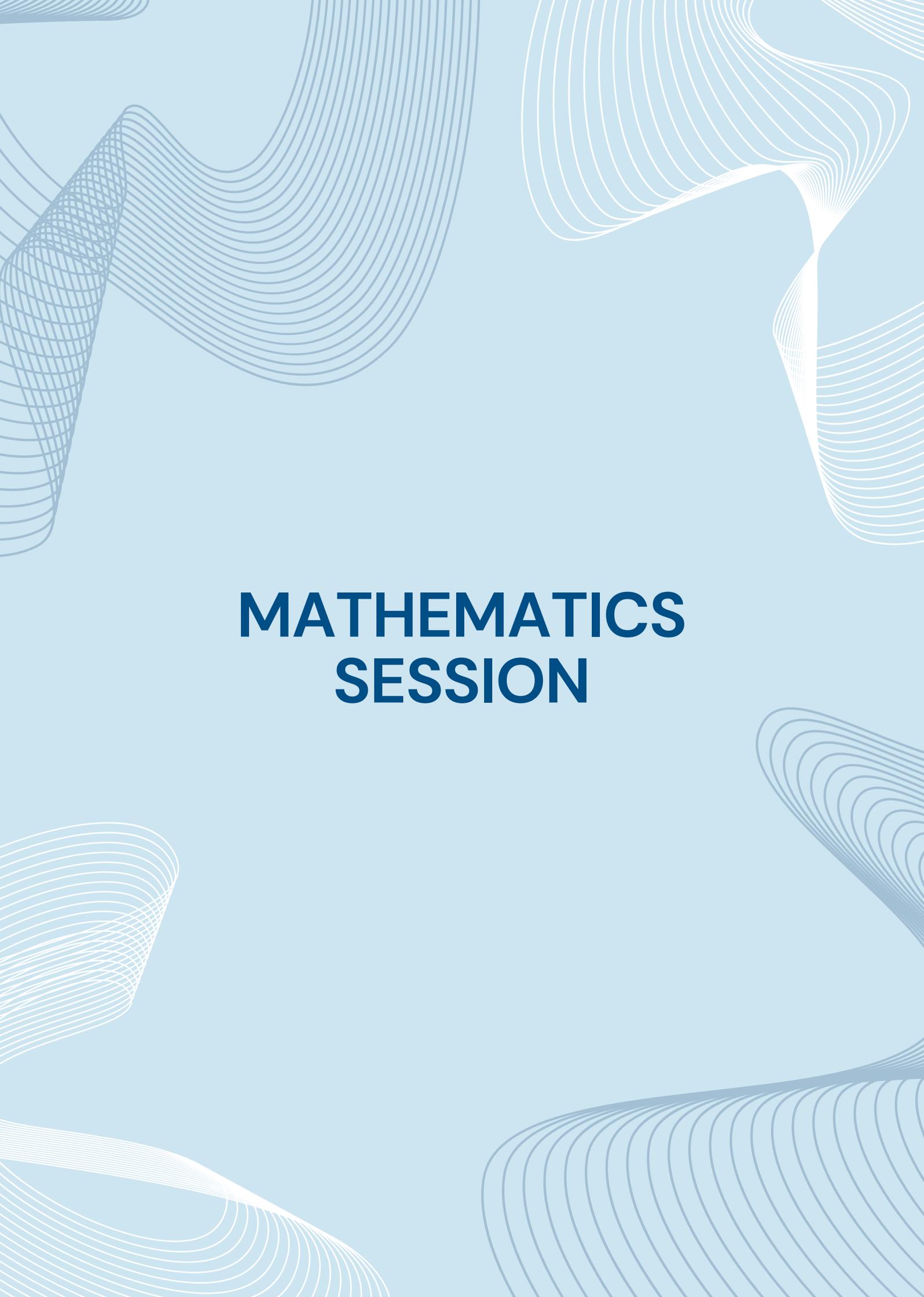
MATHEMATICS
SESSION

Numerical Solutions of Highly Sensitive Troesch's Problem

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We propose residual method to approximate Troesch's problem, which is inherently unstable two-point boundary value problem, for large values of the sensitivity parameter λ. Application of the Residual method is based on the construction of the approximate solution using Bézier curves and determination of the unknown control points by minimizing the residual function. Advantage of the presented method is avoiding non-linear equations, as far as possible, while determining the control points. Residual Method is used for approximating to both initial slope and the exact solution of Troesch's problem. Numerical results for λ = 10, 30 and 80 are compared with theoretical aspects and the results of the other methods. It is seen that high order accuracy is obtained. Numerical experiments confirm the effectiveness of the suggested approach.

Keywords: Troesch's problem, Bernstein polynomials, non-linear differential equations, continuous linear approximation, Bézier curves, unstable boundary value problems.

F-supplemented modules

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The notion of a module is obtained essentially by a generalization of that of a vector space, so it plays an important role in the theory of linear algebra. Modules are also of great importance in the higher reaches of group theory and ring theory, and are fundamental to the study of homological algebra, category theory and algebraic topology, for example.

In this talk, we will investigate a class of modules that are important in ring and module theory; supplemented modules. They were introduced in order to characterize semiperfect modules, that is, projective modules whose factor modules have projective covers. Generalizations of this class of modules are widely studied in the literature. As a new generalization, we will introduce F-supplemented modules. Let R be an associative ring with unity, let M be a left R-module and let U, V and F be submodules of M with F proper. We call V an F-supplement of U in M if it is minimal in the collection of submodules X of M containing F such that M=U+X. If every submodule of M has an F-supplement in M, then we call M an F-supplemented module. We will give fundamental properties of F-supplemented modules, and characterize them in terms of their certain submodules.

Keywords: (F-)supplement submodule, (F-)small submodule, (F-) supplemented module

Generalized entropy optimization methods (GEOM`s) in theory of stochastic differential equations

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MaxEnt method represents distributions of random variable X using Shannon Entropy measure

$$H(x) = -\sum_{i=1}^{n} p_i \ln p_i$$

Theas measure maximized by using linear independent conditions generated by given frequencies of statistical data and linear independent characterizing moment functions and moment values. The number of linear independent conditions must be smaller than the number of given frequencies "" of statisties data. MaxMaxEnt method allows to obtain MaxMaxEnt distribution in the given set of linear independent characterizing moment functions.

By using linear conditions generated "n" number of frequencies of statistical data and "m" number of linear independent characterizing moment functions MaxEnt distributions is $\sum_{i=1}^{n} \binom{r}{m}$, where m+1<n and every conditions of "m" things "r" at a time defines $\binom{r}{m}$ number of MaxEnt distributions. Suppose the set of N number of MaxEnt distributions is described as M.

MaxMaxEnt distribution is MaxEnt distribution from M Shannon entropy value of which is the gretest among distributions from M. MinMaxEnt method allows to obtain MinMaxEnt distribution in the set of M MaxEnt distributions. MinMaxEnt distribution is MaxEnt distribution from M Shannon Entropy of which is the least among MaxEnt distribution of M. MinEnt method represents distributions of random variable Y using Kullback–Leibler entropy measure

$$H(Y) = \sum_{i=1}^{n} p_i \ln \frac{p_i}{q_i},$$

where $(q_1, q_2, ..., q_n)$ is given distribution.

This measure minimized by using linear independent conditions generated by given frequencies of statistical data and moment values. The number of linear independent conditions generated by given frequencies of statistical data and linear independent characterizing moment functions and moment values as in the case of MaxEnt distribution.

Let as the set of numbers of MinxEnt distributions is discribet as MaxMinxEnt distribution is MinxEnt distribution from Kullback- Leibler entropy value of which is the greatest among distributions from . MaxMinxEnt method allows to obtain MaxMinxEnt distribution in the set of

The solution of Stochastic differential equation in stochastic proses which at fixed set value of time is random variable. Consequently, Generalized Entropy Methods has many applications in theory of Stochastic differential equations.

In this investigate Generalized Entropy Optimization Methods are formulated in the move applicability form in theory of Stochastic differential equation and other fields of mathematical statistics.

STATISTICS
SESSION

Weighted Robust Regression Forest

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Random Forest Regression, also known as Regression Forest (RF), is an ensemble method that excels at handling large datasets, dealing with missing predictor values, and addressing issues of multicollinearity. Despite its strengths, RF is still vulnerable to the influence of outliers, which continues to be an area of active research. In this study, our aim is to enhance the robustness of RF by implementing a robust loss function along with robustly weighted predictors, a combination that has not previously been used with the Regression Forest method. We empirically examine its predictive performance on both contaminated and uncontaminated simulated datasets.

Keywords: Ensemble method, random forest, regression, robustness.

Statistical methods for metal coordination analysis in structural biology

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This study introduces innovative statistical methods for designing prior information about metal coordination geometries, aiming to improve the modeling and analysis of metal coordination in macromolecular structures. We developed techniques to extract coordination geometry information from the Crystallography Open Database (COD) and applied statistical tools, including Procrustes analysis and estimation based on the symmetrised von Mises distribution, to analyze metal environments. From an initial dataset of 429,579 metal environments extracted from COD, we analyzed 228,063 single-metal cases, leading to the classification of 189,671 distinct metal coordination geometries.

Our method involves a multi-stage filtering process and integrates several statistical strategies, such as exact structural matching, element-type matching, and coordination class matching, to compile comprehensive stereochemical data. This approach was implemented in a new program, MetalCoord, which successfully updated 625 of 756 metal-containing entries in the Chemical Component Dictionary of the Protein Data Bank. The effectiveness of these statistical methods was illustrated through various case studies, including the refinement of haem-like components and hybrid iron-sulphur-oxygen clusters.

The statistical framework developed in this study significantly enhances the modeling of metal-containing macromolecular structures and provides a robust foundation for analyzing metal coordination in structural biology.

ATA Forecasting Method

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In this study, I will introduce you a new benchmark time series method in an important area of statistics and our lives. This method is better, simpler, faster and more trouble-free than all the other major methods in the literature.

Keywords: Time series, forecasting, m-competitions, exponential smoothing.
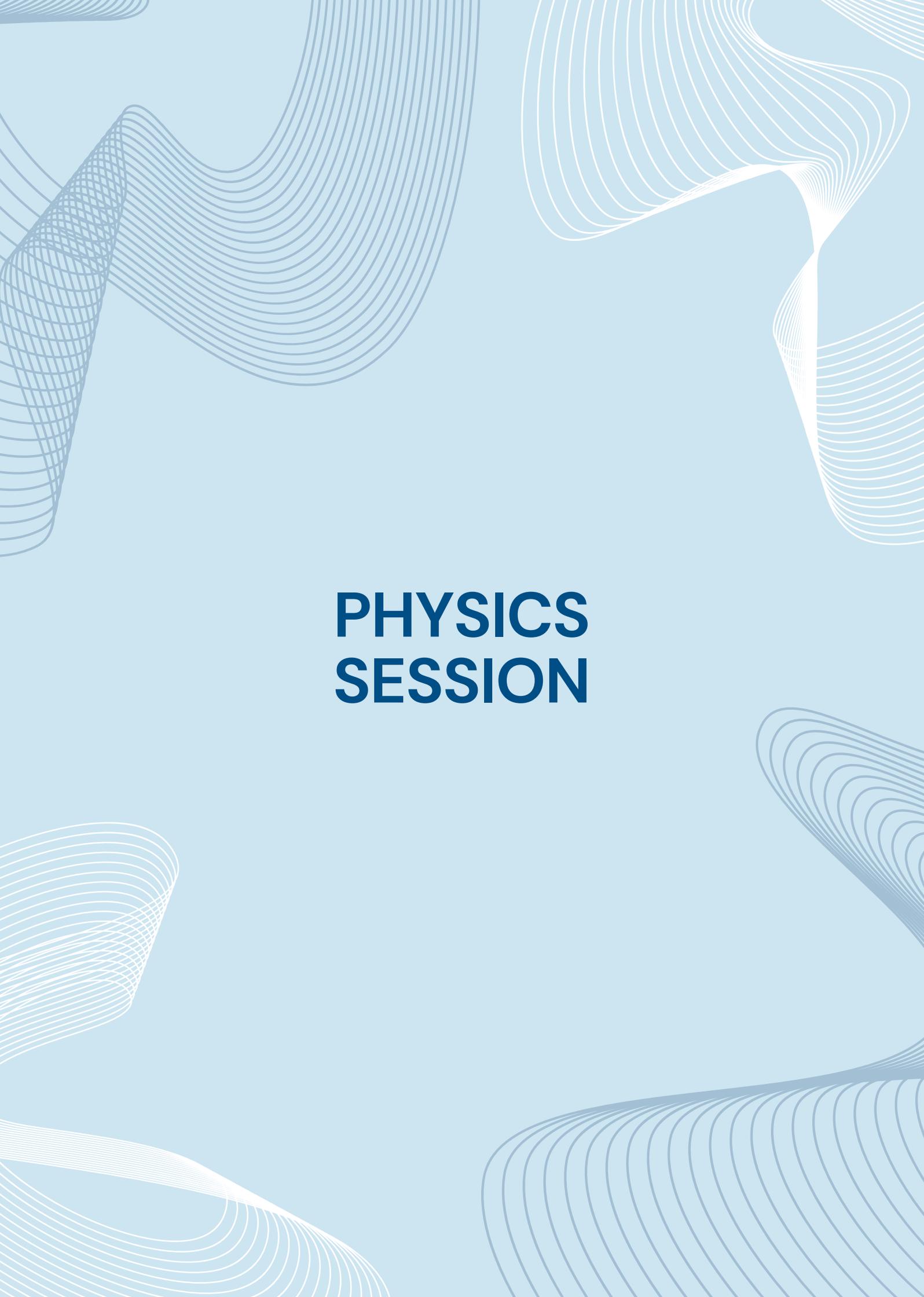
PHYSICS SESSION

Phase space to the q-deformed quantum oscillator as a tool for description of the bluffing phenomenon in the untrusted supply–demand relationship

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The main part of the talk is based on the recently published paper named "Description of the Bluffing Phenomenon in the Untrusted Seller–Buyer Relationship via the Wigner Function of the q-Deformed Quantum Harmonic Oscillator Model". We apply the q-deformed quantum harmonic oscillator model to describe the untrusted seller-buyer relationship. Here, the square modulus of the wavefunctions of the mentioned above quantum system in the position representation describes the demand law by the buyer, whereas, the square modulus of its wavefunctions in the momentum representation acts as a supply law by the seller. A simpler version of this approach can be found in literature. As an example of the bluffing phenomenon, one considers the first excited state of its Wigner function in the phase space and shows that the finite-difference differentiation parameter h (or the deformation parameter q generated through this differentiation parameter) can be considered as a parameter defining the level of the bluffing phenomenon in this untrusted relationship. Different limit relations and special cases leading to several attractive scenarios are also studied.

Keywords: Wignerfunction, quantum harmonic oscillator.

Biological Activity Investigations of Malvidin and It's Glucosides by using DFT and Molecular Docking Studies

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Anthocyanins have attracted a lot of attention in pharmacological research due to their brilliant color, high water solubility, and favorable biological effects. Their glycoside form, which is linked to sugar molecules, is more stable and less susceptible to destruction from light, pH changes, and heat. In this presentation, the biological activity and the potential inhibition properties of Malvidin and its glucosides on SARS-CoV-2 protein will be discussed by using Density Functional Theory (DFT) methods and Molecular Docking. The results will be compared to one of the most effective drugs that has been used during the Covid-19 pandemic.

Keywords: Anthocyanin, Malvidin, DFT, Molecular docking, SARS-CoV-2.

Evaluation of the water quality and its suitability for drinking and agricultural use in Gubadli district of Azerbaijan

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The capacity for water resources to meet various needs (domestic, livestock, and irrigation) has led to water sources being over-stressed, leading to the scarcity of quality water. Various reasons can be advanced to account for this water scarcity, including: population increase, climate change, environmental degradation, weak and inadequate institutional capacities, and growing poverty levels in the country. Climate variability and change has also significantly altered rainfall patterns and amounts, thereby effecting the replenishment rate of water bodies. Hydro-chemical analysis and subsequent water quality evaluation often reveals quality of water that is suitable for domestic consumption, agriculture, and industrial purposes, as well as aiding in the management of the water resource. This study aims to assess the quality of water resources in Gubadli district, Azerbaijan, and evaluate their suitability for drinking and agricultural purposes. During the research, analyzes were carried out on water samples taken from 7 sampling points. These points include various water sources, rivers, drinking water sources and technical water. For each sample, the concentration of heavy metals (Cu, Fe, Mn, Mo, Ni, Zn), the main ion composition (Ca, Mg, Na, K, Cl, SO4, HCO3), physical and chemical indicators of water (pH, EC, TDS, DO) were measured. Indicators such as SAR (Sodium Adsorption Ratio), SSP (Sodium Saturation Percentage), RSC (Residual Sodium Carbonate) and KR (Kelly's Ratio) were also calculated to determine the sodification effect on the soil during the use of water for agricultural purposes. As a result of the study, it was determined that the water exceeded WHO standards in terms of heavy metals and chemical composition. Especially high concentrations of iron and manganese have a negative effect on the quality of drinking water. However, pH, TDS, and ion concentrations can be generally considered suitable for agricultural water. The use of water as technical water increases the risk of potential pollution for the environment. Therefore, water sources in Gubadli district should be regularly monitored and necessary measures should be taken against pollution.

Elimination of interference affecting analytical signals of ICP–MS

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Regardless of the state of the aggregate, physical methods are usually used to measure the composition of substances. Among these methods, the mass spectrometric method prevails. Despite being a very powerful technique, spectral and non-spectral interferences have been observed in ICP-MS that affect the analysis results. Therefore, in the review, starting from the sample preparation, passing the sample through the atomizer, exiting the atomizer chamber and entering the plasma, the ionization process, and the transport of the captured ions to the detector, the causes of interferences were investigated and elimination methods were proposed in literature. A review was compiled using many fundamental studies related to non-spectroscopic and spectroscopic interferences.

Spectroscopic interferences are easier to eliminate or reduce than non-spectroscopic interferences (aka matrix effects). Because here we are looking at another ion observed with the same charge and mass ratio as the analyte. However, this is not the case for non-spectroscopic ones. Because it is caused by many reasons, and it is impossible to give an opinion about the source of these interferences. In order to explain the causes of matrix effects, it is necessary to look at the processes that the sample goes through during the analysis.

First, the procedures performed during the concentration of the sample and its transformation into a solution were considered. If it is dissolved with acid, attention should be paid to the percentage of acid. Then giving a physical explanation of the events that occur in the plasma. The selection of internal standards and their compatibility with the physical and chemical properties of the analytes were considered.

Keywords: ICP-MS, interferences, internal standart.

Artificial Neural Network Approach to Spin Models

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The application areas of Artificial Neural Networks in technology and basic sciences are growing rapidly. From a physics perspective, the application areas of Artificial Neural Networks continue to develop in a wide range from differential equation solutions to quantum physics and fluid dynamics .

Statistical Physics has an important place in understanding the functioning mechanisms of artificial neural networks. In addition, the use of Artificial Neural Networks in solving some models within the scope of statistical physics is also developing. Magnetic models are included in this class of models, and the solution of a basic model such as the Ising model with artificial neural networks was realized with Boltzmann machines developed by Geoffery Hinton, one of the 2024 Nobel Prize winners in Physics. In this talk, a brief introduction will be made to Boltzmann machines that can learn probability distributions, and strategies for using them in solving the Ising model will be introduced. In addition, the possible use of Boltzmann machines in solving the high-spin Ising model will be evaluated, first results will be presented, and the potential for use in other models will be evaluated.

Keywords: Magnetic models, artificial neural network, Boltzmann machines, Ising model.

THIRD INTERNATIONAL BILATERAL WORKSHOP ON NATURAL SCIENCE BETWEEN DOKUZ EYLUL UNIVERSITY AND AZERBAIJAN NATIONAL ACADEMY OF SCIENCES