ICSAS 4th INTERNATIONAL CONGRESS ON MATHEMATICS

April 10 - 12, 2026

İZMİR

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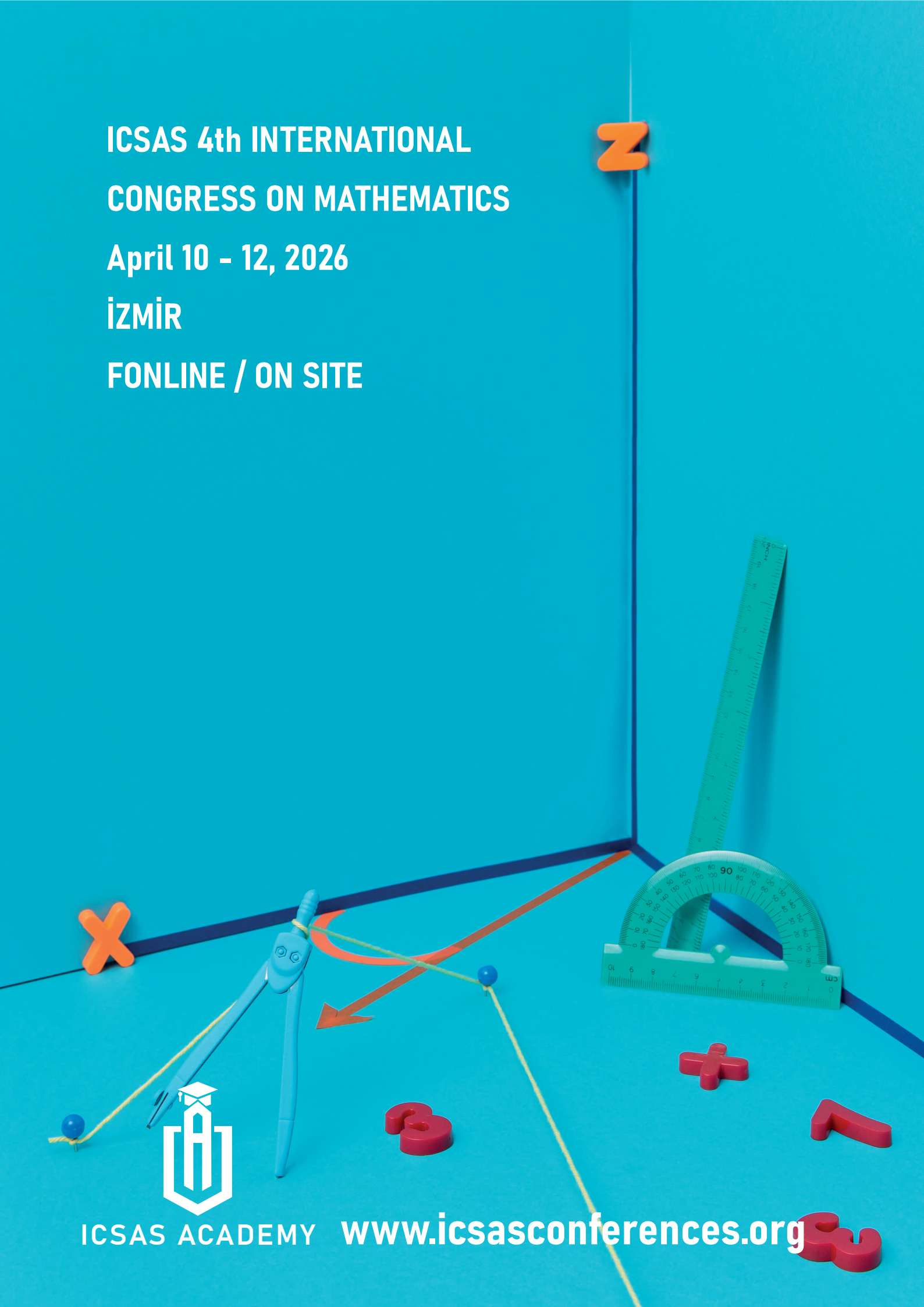

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ICSAS 4TH INTERNATIONAL CONFERENCE ON MATHEMATICS
APRIL 10 – 12, 2026
IZMIR

Edited By
ASSOC. PROF. DR. MOHAMMAD ALI SOLTANI

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ASSOCIATION & ACADEMIC INCENTIVES :
In the conference 6 papers have been presented by Turkish participants and 15 papers by international participants.
Members of the organizing committees of the conference perform their duties with an "official assignment letter"

Web: www.icsaskongresi.org Contact: icsaskongre@gmail.com

CONFERENCE ID

ICSAS 4TH INTERNATIONAL CONFERENCE ON MATHEMATICS

DATE – PLACE

APRIL 10 – 12, 2026

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ORGANIIZATION

ACADEMY GLOBAL CONFERENCES & JOURNALS

EVALUATION PROCESS

All applications have undergone a double-blind peer review process.

PARTICIPATING COUNTRIES

Turkey - Iran- Albania – Russia- Egypt- **Greece – Kazakhstan- India – Algeria-**

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PRESENTATION

Oral presentation

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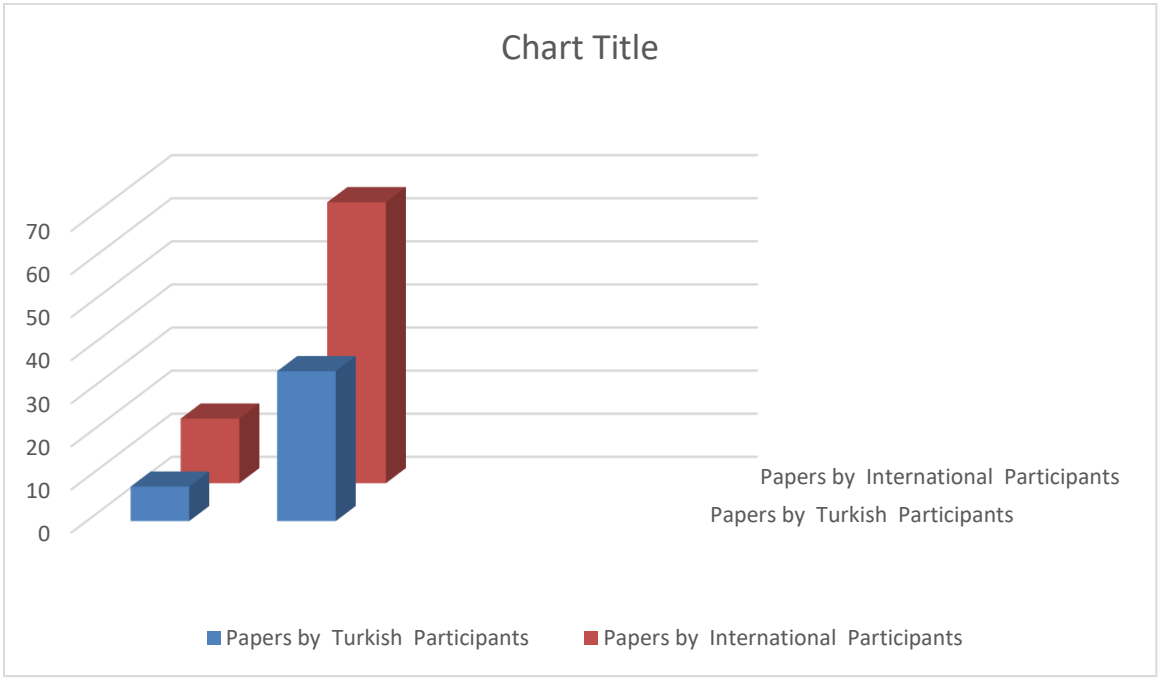
	Number of paper	*%*
Papers by Turkish Participants	8	34,78
Papers by International Participants (8 Countries.)	15	65,22



T.C.
GAZİANTEP ÜNİVERSİTESİ REKTÖRLÜĞÜ
Tıp Fakültesi

Sayı : E-98102723-903.07-475454
Konu : Görevlendirme Talebi

REKTÖRLÜK MAKAMINA

İlgi : 27.03.2024 tarihli ve E--903.07-474236 sayılı yazı

Fakültemiz Tıbbi Biyokimya Anabilim Dalı'nda görevli öğretim üyesi Prof. Dr. Hülya ÇİÇEK'in Yükseköğretim Genel Kurulunun 15.06.2023 tarihli, 10 sayılı oturumunda alınan 2023.10.183 sayılı kararı gereğince Doçentlik Başvuru Şartlarında bulunan ve doçent olacak adaylardan istenen "Diğer uluslararası/ ulusal bilimsel toplantının düzenleme komitesinde resmi olarak görevlendirilmiş üniversite akademisyen temsilcisi bulunması zorunludur." maddesi gereğince, Academy Global Conference & Journals tarafından yapılan kongrelerin düzenleme kurullarında yolluksuz ve yevmiyesiz olarak görevlendirilme talebi ile ilgili dilekçesi ekte gönderilmiştir

Adı geçen öğretim üyesinin Academy Global Conference & Journals tarafından yapılan kongrelerin düzenleme kurullarında yolluksuz, yevmiyesiz olarak görevlendirilmesinde Dekanlığımızca bir sakınca bulunmamaktadır.

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Prof.Dr. Şevki Hakan EREN
Dekan

OLUR

Prof.Dr. Arif ÖZAYDIN
Rektör

Ek:İlgi Dilekçe (1 Adet)

Dağıtım:
Gereği:
Tıbbi Biyokimya Anabilim Dalı Başkanlığı

Bilgi:
Sayın Prof.Dr. Hülya ÇİÇEK

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Bilgi için : Hüseyin Temel
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Meeting ID: 885 7151 8350

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ÖNEMLİ AÇIKLAMA (Lütfen okuyunuz)

- ZOOM bağlantısı için yukarıda verilen bağlantıyı veya yine yukarıda verilen giriş bilgilerini kullanabilirsiniz.
- **Oturum içerisinde en KIDEMLİ olan moderator olarak seçilir. Moderatörün oturum düzenini gözetmesi, akademisyen adaylarını yönlendirmesi beklenmektedir.**
- Oturuma bağlanmadan önce Salon numaranızı adınızın önüne aşağıdaki gibi ekleyiniz. Bu sayede kongre açılışında beklemeden oturumlarınıza gönderilebileceksiniz. Ör. 5 Ahmet Ahmetoglu
- **Sunum süresi 10 dakikadır. Bu sürenin aşılmamasını moderatörler temin edecektir.**
- Sunum sonrası 5 dakikayı geçmeyen soru-cevap, tartışma süresi verilmektedir.
- **Sunumlar TÜRKÇE veya İNGİLİZCE yapılabilmektedir.**
- Kameralar, oturum süresince toplam % 70 oranında açık olmak zorundadır.
- **Sunum yapan katılımcının kamerası açık olmak zorundadır.**
- Sunum yapmak zorunludur. **Herhangi bir nedenle sunum yapmamış olan katılımcıya sertifika verilmesi ve çalışmasının yayınlanması sözkonusu olamaz.**
- Katılımcı, kendi oturumda, oturum bitene kadar bulunmak zorundadır.
- Katılımcıların kendi oturumları dışındaki oturumlara katılma zorunluluğu yoktur.
- ZOOM platformunun kapasite sınırı nedeniyle, DİNLEYİCİ, sadece kapasite izin verdiği sürece kabul edilebilmektedir.
- **SADECE ÇALIŞMADA YAZAR OLARAK GEÇEN KİŞİLER SUNUM YAPABİLİR !**

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- or Personal Link Name” and solidify the session.
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- The application works on tablets, phones and PCs.
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- During the session, your camera should be turned on **at least %70** of session period
- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

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- Make sure your computer has a microphone and is working.
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- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.
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10 Nisan 2026 / April 10, 2026 / 11:00 – 13:00 Time zone in Türkiye (GMT+3)				
Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 1	**Doç. Dr. LATİFE CEYDA İRKİN**	1	GENETIC ENGINEERING AND SYNTHETIC BIOLOGY	Doç. Dr. LATİFE CEYDA İRKİN
		2	BIOMATERIALS AND NEXT GENERATION APPLICATIONS	Doç. Dr. LATİFE CEYDA İRKİN
		3	HIERARCHICAL DYNAMICS IN HUMAN FRATAXIN: BRIDGING NANOSECOND LOCAL FLUCTUATIONS TO MICROSECOND-MILLISECOND CONFORMATIONAL EXCHANGE THROUGH TRANSFER ENTROPY ANALYSIS OF MOLECULAR DYNAMICS SIMULATIONS	Res. Asst. Kevser Kübra Kırboğa Prof. Dr., Ecir Uğur Küçüksille
		4	THE HIDDEN DANGER IN HONEYCOMBS: THE IMPACT OF CHEMICAL RESIDUE RISKS ON BEE AND HUMAN HEALTH	Dr., Ekin VAROL Prof. Dr., Banu YÜCEL
		5	THE PARADIGM EFFECT OF HONEY BEES IN PLANT POLLINATION	Dr., Ekin VAROL Prof. Dr., Banu YÜCEL
		6	DISULFIDPTOSIS AND THE 2-HG AXIS IN NEURO-ONCOLOGY: CSF-BASED MULTIMODAL THERANOSTIC APPROACHES	Assist. Prof. Dr. Halil İbrahim AKBAY,
		7	THE ONCOMETABOLOMIC VISION OF CLINICAL BIOCHEMISTRY: METABOLIC REPROGRAMMING IN CANCER AND SPECIFIC ONCOMETABOLITES	Assist. Prof. Dr. Halil İbrahim AKBAY,

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Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 2	**Assistant Professor İbrahim GECİLİ**	1	IMPACT OF BORON FERTİLİZATİON ON YİELD AND OİL QUALİTY OF SUNFLOWER (Helianthus annuus L.)	Dr., Hakan YILDIZ
		2	STRATEGIC RATIONAL REDESIGN AND MULTI-PARAMETRIC IN SILICO PROFILING OF A NOVEL PARABUTOPORIN MUTANT (PARP-MTN) FOR ENHANCED ANTIMICROBIAL EFFICACY	Master's Student Derya ÇAĞATAY KAYIŞ Dr.Öğr.Üyesi Handan Açelya KAPKAÇ Doç.Dr. Hülya KARACA ATSOROS
		3	IRISIN'S ASSOCIATION WITH GENE AND MIRNA EXPRESSION ALTERATIONS IN AN MPP^{+}-INDUCED IN VITRO PARKINSON'S DISEASE MODEL	Tutku KARABAŞ Arş. Gör Hilal SANCAR Öğr. Gör. Dr. Deniz ŞUMNULU Prof. Dr. Lokman AYAZ
		4	PROTECTIVE EFFECTS OF GALLIC ACID AGAINST ARSENIC-INDUCED CYTOTOXICITY IN Caco-2 CELLS	Assistant Professor İbrahim GECİLİ Associate Professor Adem GÜNER
		5	PROTECTIVE ROLE OF SINAPIC ACID AGAINST HYDROGEN PEROXIDE-INDUCED OXIDATIVE NEURONAL INJURY IN SH-SY5Y CELLS	Assist. Prof. Dr. İbrahim Gecili Assoc. Prof. Dr. Adem Güner
		6	ITIR BİTKİSİNİN ENDOFİTİK FUNGAL ÇEŞİTLİLİĞİ	Sanem UZGUR Sevinç KARAGÖZ Doç. Dr. Gülsüm Ebru ÖZER UYAR
		7	KULLANILMIŞ KAHVE ATIĞI EKSTRAKTININ FİTOPATOJENİK KÜFLERE KARŞI ANTİFUNGAL ETKİSİNİN DEĞERLENDİRİLMESİ	Ceren KAPLAN Doç. Dr. Gülsüm Ebru ÖZER UYAR

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Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 3	**Dr. Öğr. Üyesi Ebru BOĞA BARAN**	1	YAPAY ZEKÂ DESTEKLİ EĞİTİM ARAÇLARININ ERKEN ÇOCUKLUK EĞİTİMİNDE KULLANIM POTANSİYELİ	Dr. Öğr. Üyesi Ebru BOĞA BARAN
		2	DENEYSEL YÖNTEMLERİN SANATTA KULLANIMI: ISI İLE FORM DÖNÜŞÜMÜ ÜZERİNE BİR UYGULAMA	Dr. Öğretim Üyesi SİBEL ARMAĞAN BENEK
		3	FROM TEXT TO CRITICAL TRANSFORMATION: EXPLORING CRITICAL READING AND WRITING PRACTICES IN ELT TEACHER EDUCATION	Asst. Prof. Dr. MANOLYA SAĞLAM
		4	REFRAMING LISTENING AND PRONUNCIATION PEDAGOGY THROUGH IELTS-ORIENTED TASKS: A CASE STUDY IN ELT TEACHER EDUCATION	Asst. Prof. Dr. MANOLYA SAĞLAM
		5	EXAMINING PRIMARY SCHOOL TEACHERS' NEEDS IN SCIENCE TEACHING: A MIXED METHODS STUDY	Dr., ZAFER HANEDAR Dr. Öğrt. Üyesi, ALİ RIZA ERDEM
		6	ENGLISH CURRICULUM CHANGE AND TEACHER AGENCY UNDER TÜRKİYE'S NEW EDUCATION MODEL	Lecturer PhD, ÖZLEM UTKU BİLİCİ
		7	ARTIRILMIŞ GERÇEKLİK DESTEKLİ FEN ÖĞRETİMİ SÜRECİNDE ÖĞRETMEN ADAYLARININ EĞİTİM TEKNOLOJİLERİ ÖZYETERLİLİĞİ VE BİLGİ İŞLEMSEL DÜŞÜNME BECERİLERİ ARASINDAKİ İLİŞKİ	Prof. Dr. Ali Günay BALIM Prof. Dr. Yasin ÖZARSLAN Doktora Öğrencisi, Betül ÖZTAŞ Doktora Öğrencisi, Ece ALTAY
		8	SANAL SOSYAL DESTEK VE SOSYAL ONAY İHTİYACININ SOSYAL VE DUYGUSAL YALNIZLIK ÜZERİNDEKİ YORDAYICI ROLÜ: GENÇ YETİŞKİNLER ÖRNEĞİ	Yüksek Lisans Öğrencisi, Beril YALAMA Dr. Öğr. Üyesi Muhammet Fatih YILMAZ
		9	TÜBİTAK 2209-A PROJESİ KAPSAMINDA TEZHİP SANATI İLE TOPLUMSAL KATKI: "KADIN ELİYLE ALTIN RENKLER"	Ayşenur ASKER Doçent, Betül COŞKUN ÇELİK

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Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 4	**Assistant Professor ARZU USLU**	1	ASSESSMENT OF NUMBER SENSE SKILLS IN PRIMARY SCHOOL STUDENTS WITH HEARING LOSS	Audiologist, NAZLI ÖZSÖZ Prof. Dr., PELİN PİŞTAV AKMEŞE
		2	EFFECTS OF PRENATAL YOGA ON OXIDATIVE STRESS AND ITS CONTRIBUTIONS TO MATERNAL–FETAL HEALTH	Dr. Öğr. Üyesi Suzan ONUR Uzm. Ebe Hatice TOPÇU
		3	THE RELATIONSHIP BETWEEN SLEEP DISORDERS, MATERNAL FATIGUE, AND OXIDATIVE STRESS DURING PREGNANCY	Dr. Öğr. Üyesi Suzan ONUR Zaytuna HASHİMİ
		4	INTERGENERATIONAL FAMILY TRAUMA AND PSYCHOLOGICAL RESILIENCE: THE MEDIATING ROLE OF PSYCHOLOGICAL FLEXIBILITY	Asst. Prof. Dr. NURTEN ARSLAN IŞIK Res. Asst. İREM NUR SANDIKÇI
		5	CYBERTHERAPY-SUPPORTED ONCOLOGICAL CARE IN OLDER ADULTS WITH CANCER	Assistant Professor ARZU USLU
		6	İNVAZİV OLMAYAN DOĞUM ÖNCESİ TESTLER VE CİNSİYET SEÇİMİ: ETİK BOYUT VE GÜNCEL UYGULAMALAR	Dr. Ebe, TUĞBA KAVAS Prof. Dr., ÖZLEM KARABULUTLU Dr. Öğr. Üyesi, CANSU MİNE AYDIN Uzman Ebe, YAĞMUR KOTANCI Öğr. Gör. Dr., GÜLHAN AKDEMİR
		7	POLİKİSTİK OVER SENDROMU VE TEDAVİ YÖNTEMLERİ	Dr. Ebe, TUĞBA KAVAS Prof. Dr., ÖZLEM KARABULUTLU Uzman Ebe, YAĞMUR KOTANCI Dr. Öğr. Üyesi, CANSU MİNE AYDIN Öğr. Gör. Dr., GÜLHAN AKDEMİR
		8	EVALUATION OF OPERATING ROOM NURSES' EXPERIENCE, KNOWLEDGE LEVEL, CHALLENGES, AND INTRAOPERATIVE COMMUNICATION IN MICROSURGERY	Dr. Yavuz ÖNEL

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Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 5	**Prof. Dr. Meryem YAVUZ Van GİERSBERGEN**	1	PREOPERATIVE NURSING CARE COMPETENCE AMONG NURSING STUDENTS: FINDINGS FROM NURSING EDUCATION RESEARCH	Prof. Dr. Meryem YAVUZ Van GİERSBERGEN Nurse Beyza SÜZEN
		2	EVIDENCE-BASED PRACTICE COMPETENCE İN NURSING EDUCATION	Prof. Dr. Meryem YAVUZ Van GİERSBERGEN Nurse Beyza SÜZEN
		3	GENERAL SELF-EFFICACY AMONG TURKISH NURSING STUDENTS: A LITERATURE REVIEW	Semiha TİMOÇİN Prof. Dr. Meryem YAVUZ Van GİERSBERGEN
		4	AN EXAMINATION OF ACADEMIC SELF-EFFICACY AMONG STUDENTS IN TÜRKIYE	Semiha TİMOÇİN Prof. Dr. Meryem YAVUZ Van GİERSBERGEN
		5	GENERATIONS OF PATIENT-CENTERED PERSPECTIVES IN CANCER SURGERY: ALIGNING TREATMENT PATHWAYS WITH PATIENT VALUES	Öğr. Gör. Tülin KARAKOÇ Prof. Dr. Meryem YAVUZ Van GİERSBERGEN
		6	PREPARATION FOR COLORECTAL CANCER SURGERY: STUDIES USING THE PCSQ-PRE 24	Öğr. Gör. Tülin KARAKOÇ Prof. Dr. Meryem YAVUZ Van GİERSBERGEN
		7	MAPPING RESEARCH ON DIABETIC FOOT CARE İN NURSING: AN ANALYSIS OF GRADUATE THESES İN TÜRKIYE	Arş. Gör. Züleyha SÖNMEZ Prof. Dr. Meryem YAVUZ Van GİERSBERGEN

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10 – 12 Nisan 2026
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Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 6	**Prof. Dr. NALAN DEMİRCİOĞLU**	1	SİNEMA UYARLAMALARI ÜZERİNDEN KONUT İÇ MEKÂNININ KÜLTÜREL KODLAR BAĞLAMINDA ANALİZİ: BENİM DÜNYAM FİLMİ	Yük. Lisans Öğrencisi, MERVE KARAKURT Yük. Lisans Öğrencisi, ESİN ARSLAN Doç. Dr., HARE KILIÇASLAN
		2	MİMARLIK EĞİTİMİNDE UZAMSAL YETENEĞİN ÖNEMİNE BİR BAKIŞ	Doktora Öğrencisi, ÖZLEM NUR SAMANCI Doç. Dr., HARE KILIÇASLAN
		3	AİLE SAĞLIĞI MERKEZLERİNDE HAVALANDIRMA ve BULAŞ RİSKİ: CFD ANALİZİ	KÜBRA YILDIZ ULAŞ Dr. Öğr. Üyesi MELTEM EZEL ÇIRPI
		4	AKILLI ŞEHİRLER VE YAPAY ZEKA BAĞLAMINDA ÇEVRESEL SÜRDÜRÜLEBİLİRLİK ARAŞTIRMALARIN BİBLİYOMETRİK ANALİZİ	Yük. Lis. Öğr. Mevhibe DEMİRCAN Yük. Lis. Öğr. Gülbanu ÇUBUKÇU Prof. Dr. Nalan DEMİRCİOĞLU
		5	YEŞİL ÇATI SİSTEMLERİNİN SÜRDÜRÜLEBİLİRLİK VE İKLİM DEĞİŞİKLİĞİ ÜZERİNDEKİ ETKİLERİ: BİR BİBLİYOMETRİK ANALİZ	Yük. Lis. Öğr., GÜLBANU SÜMEYYE ÇUBUKÇU Yük. Lis. Öğr., MEVHİBE DEMİRCAN Prof. Dr. NALAN DEMİRCİOĞLU
		6	EVALUATION OF CULTURAL BUILDINGS DESIGNED WITH A PARAMETRIC DESIGN APPROACH WITHIN THE SCOPE OF ICONIC STRUCTURES	M.Arch., Edanur BİRİNCİ Prof. Dr. Çiğdem Belgin DİKMEN
		7	EVALUATION OF ICONIC STRUCTURES IN THE CONTEXT OF SUSTAINABLE TOURISM THROUGH EXAMPLES	M.Arch., Edanur BİRİNCİ Prof. Dr. Çiğdem Belgin DİKMEN

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Salon	Moderator		Bildiri No ve Başlığı / Paper ID and Title	Authors
HALL / SALON 7	**Asst. Prof. Dr. DÜNYA KARAPINAR**	1	BIFURCATION ANALYSIS AND CHAOS CONTROL IN A NONSTANDARD DISCRETIZED POPULATION MODEL	Cahit KÖME
		2	DYNAMICAL ANALYSIS OF A MEMORY-DEPENDENT 3D POPULATION MODEL	Merve KARTAL Cahit KÖME
		3	DOUBLE DİZİLER İÇİN RİESZ LACUNARY DÜZGÜN İNTEGRALLENEBİLİRLİK, RİESZ İSTATİSTİKSEL YAKINSAKLIK VE RİESZ KUVVETLİ YAKINSAKLIK	Beyzanur COŞAR Prof.Dr.Mustafa YILDIRIM
		4	MEAN SQUARED ERROR MATRIX COMPARISONS BETWEEN WEIGHTED MIXED REGRESSION ESTIMATION	Asst. Prof. Dr. DÜNYA KARAPINAR MURAT POLAT Assoc. Prof. Dr. NİMET ÖZBAY Prof. Dr. SELAHATTİN KAÇIRANLAR
		5	SOME INTEGRAL TYPE BEST PROXIMITY CIRCLE RESULTS ON G-METRIC SPACES	Hatice Merve PEKER Assoc. Prof. Dr. Nihal TAŞ
		6	λ-STATISTICAL CONVERGENCE OF ORDER α IN CONE METRIC SPACES	Arş. Gör. SÜLEYMAN SARIKAYA Prof. Dr. YAVUZ ALTIN

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HALL / SALON 8	**Associate Prof. Makbulenur ONUR**	1	ARTIFICIAL INTELLIGENCE IN LANDSCAPE ARCHITECTURE EDUCATION	Prof. Dr. Elif Merve ALPAK Prof. Dr. Tuğba DÜZENLİ
		2	SUSTAINABLE URBAN OPEN SPACE DESIGN	Prof. Dr. Elif Merve ALPAK Prof. Dr. Tuğba DÜZENLİ
		3	EFFECTS OF WINDOW-TO-WALL RATIO AND SOLAR TRANSMITTANCE ON ENERGY PERFORMANCE IN HOT CLIMATES	Res. Assist. Dr. OKAN ŞİMŞEK
		4	RECONSTRUCTING TOPOGRAPHY: FORM, PERFORMANCE, AND SPATIAL EXPERIENCE IN LANDSCAPE ARCHITECTURE	Prof. Dr. SERAP YILMAZ Res.Asst. Nida KURAK SEZGİN
		5	AN ANALYSIS OF SPATIAL AFFORDANCE IN URBAN GREEN SPACES THROUGH THE LENS OF WOMEN'S EXPERIENCES: THE CASE OF TRABZON BOTANICAL GARDEN	Res.Asst., Nida KURAK SEZGİN Prof.Dr., Serap YILMAZ
		6	IMITATING NATURE: BIOMIMICRY IN LANDSCAPE DESIGN	Associate Prof. Makbulenur ONUR Asist.Prof. Dr., Demet Ulku GULPINAR SEKBAN
		7	LANDSCAPE VALUE OF ORCHID GARDENS: THE CASE OF SINGAPORE	Associate Prof. Makbulenur ONUR Asist.Prof. Dr., Demet Ulku GULPINAR SEKBAN

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HALL / SALON 1	**Assoc. Prof. Dr. Dimitri Stavros**	1	NONLINEAR DYNAMICAL SYSTEMS ANALYSIS FOR PREDICTING CHAOTIC BEHAVIOR IN ALGERIAN DESERT ECOSYSTEMS	Prof. Dr. Karim Belkacem Dr. Nadia Zerhouni Yacine Amrane
		2	OPTIMAL CONTROL THEORY APPLICATIONS IN ALGERIAN WATER RESOURCE MANAGEMENT MODELS	Assoc. Prof. Dr. Samir Lounis Amina Bouzid Karim Mansouri Zahra Haddad
		3	FRACTIONAL CALCULUS METHODS FOR SOLVING HEAT TRANSFER EQUATIONS IN INDIAN INDUSTRIAL PROCESSES	Dr. Rajesh Kumar Priya Sharma
		4	GRAPH THEORY ALGORITHMS FOR NETWORK OPTIMIZATION IN INDIAN TRANSPORTATION SYSTEMS	Prof. Dr. Sanjay Patel Anjali Desai Rohan Mehra
		5	STOCHASTIC PROCESSES MODELING FOR KAZAKHSTANI FINANCIAL MARKET VOLATILITY PREDICTION	Assoc. Prof. Dr. Gulnara Abayeva Yerzhan Tolegenov
		6	NUMERICAL SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS IN KAZAKH PETROLEUM RESERVOIR SIMULATIONS	Dr. Aizhan Kassenova Nurlan Bekbolatov Dina Sarsenbayeva
		7	DIFFERENTIAL GEOMETRY APPLICATIONS IN ANALYZING GREEK ANCIENT ARCHITECTURAL STRUCTURES	Prof. Dr. Eleni Papadopoulos Dr. Nikos Karamanlis
		8	FUNCTIONAL ANALYSIS TECHNIQUES FOR QUANTUM MECHANICS PROBLEMS IN GREEK RESEARCH	Assoc. Prof. Dr. Dimitri Stavros Maria Kostas

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HALL / SALON 2	**Assoc. Prof. Dr. Mira Gashi**	1	NONLINEAR DYNAMICAL SYSTEMS ANALYSIS FOR CHAOTIC BEHAVIOR PREDICTION IN IRANIAN HYDROLOGICAL MODELS	Dr. Soraya Karimi Ali Jafari
		2	FRACTIONAL CALCULUS APPLICATIONS IN OPTIMIZING IRANIAN RENEWABLE ENERGY GRIDS	Assoc. Prof. Dr. Hassan Tavakoli Fatemeh Hosseini
		3	GRAPH THEORY APPROACHES TO ALBANIAN URBAN TRANSPORTATION NETWORK OPTIMIZATION	Dr. Arben Hoxha Elsa Deda Prof. Dr. Luan Kuci
		4	NUMBER THEORY INVESTIGATIONS INTO ALBANIAN CRYPTOGRAPHIC SECURITY PROTOCOLS	Prof. Dr. Ivan Petrov Dr. Natalia Sokolova Mikhail Ivanov
		5	STOCHASTIC PROCESSES MODELING FOR RUSSIAN FINANCIAL MARKET VOLATILITY FORECASTING	Assoc. Prof. Dr. Mira Gashi Krenar Lleshi
		6	TOPOLOGICAL DATA ANALYSIS FOR RUSSIAN BIOMEDICAL IMAGE PROCESSING ALGORITHMS	Assoc. Prof. Dr. Elena Kuznetsova
		7	DIFFERENTIAL EQUATIONS SOLUTIONS FOR EGYPTIAN POPULATION GROWTH PROJECTIONS	Prof. Dr. Ahmed El-Sayed Dr. Fatima Mahmoud Karim Abdel Nadia Salem

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HALL / SALON 3	**Assoc. Prof. Dr. Firew Bekele**	1	MICROBIAL DIVERSITY AND FUNCTIONAL ANALYSIS IN TAIWAN HIGH-MOUNTAIN HOT SPRINGS	Prof. Dr. Li-Wei Chen Dr. Mei-Hui Lin Hao-Ting Wu Yi-Chen Huang
		2	PHYTOREMEDIATION POTENTIAL OF TAIWANESE NATIVE PLANTS FOR INDUSTRIAL WASTEWATER TREATMENT	Assoc. Prof. Dr. Chun-Yen Wang Shu-Fen Tsai
		3	GENETIC ADAPTATION MECHANISMS OF ETHIOPIAN COFFEE ARABICA VARIETIES TO DROUGHT STRESS	Dr. Alemayehu Tadesse Meron Getachew Prof. Dr. Solomon Abate
		4	BIODIVERSITY CONSERVATION STRATEGIES FOR ETHIOPIAN HIGHLAND FROG SPECIES	Assoc. Prof. Dr. Firew Bekele Tigist Demissie
		5	MOLECULAR IDENTIFICATION OF IRANIAN PISTACHIO PATHOGENS AND RESISTANCE GENES	Dr. Reza Jalali Fatemeh Karimi Prof. Dr. Mohammad Hosseini
		6	PHYTOCHEMICAL SCREENING OF MEDICINAL HERBS FROM IRANIAN ZAGROS MOUNTAINS	Assoc. Prof. Dr. Sara Mahmoudi Ali Rezaei
		7	ENDANGERED BIRD POPULATION DYNAMICS IN GEORGIAN CAUCASUS MOUNTAIN ECOSYSTEMS	Dr. Giorgi Tsivtsivadze Nino Chikhradze Lasha Kapanadze
		8	FUNGAL DIVERSITY SURVEY IN GEORGIAN BLACK SEA COASTAL FORESTS	Prof. Dr. Mariam Lomtadze Irakli Beridze
		9	GENETIC DIVERSITY ASSESSMENT OF GEORGIAN WINE GRAPE CULTIVARS	Assoc. Prof. Dr. Tamar Gelashvili Koba Kervalishvili

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HALL / SALON 4	**Assoc. Prof. Dr. Elnur Hasanov Dr. Aysel Mammadova**	1	ENZYMATIC SYNTHESIS OF NOVEL GLYCOLIPIDS FOR BIOMEDICAL APPLICATIONS USING ENGINEERED LIPASES	Prof. Dr. Lim Wei Ming Dr. Tan Soo Ling Chen Yi Xuan
		2	MITOCHONDRIAL DYSFUNCTION AND OXIDATIVE STRESS BIOMARKERS IN NEURODEGENERATIVE DISEASE MODELS	Assoc. Prof. Dr. Rajesh Kumar Ng Hui Fen Dr. Amirul Al-Ashraf
		3	BIOCHEMICAL CHARACTERIZATION OF DATE PALM PHOSPHATASES UNDER DROUGHT STRESS CONDITIONS	Dr. Ahmed El-Sayed Fatima Mahmoud
		4	METABOLIC PATHWAY ANALYSIS OF ANTIBIOTIC-PRODUCING ENDOPHYTES FROM EGYPTIAN DESERT PLANTS	Prof. Dr. Nadia Karim Omar Hassan Layla Abdel
		5	INVESTIGATION OF LIPID PEROXIDATION PRODUCTS IN CARDIOVASCULAR DISEASE PATIENTS	Assoc. Prof. Dr. Elnur Hasanov Dr. Aysel Mammadova
		6	PROTEOMIC PROFILING OF STRESS-INDUCED CHANGES IN AZERBAIJANI GRAPE CULTIVARS	Leyla Ibrahimova Kamal Gurbanov Dr. Nigar Aliyeva
		7	GLYCOGENOLYSIS REGULATION IN HIGH-ALTITUDE ADAPTED LIVESTOCK FROM KAZAKHSTAN STEPPES	Prof. Dr. Aigerim Zhumaliyeva Nursultan Bektasov
		8	MICROBIAL ENZYME DISCOVERY FOR BIOFUEL PRODUCTION FROM KAZAKH WHEAT RESIDUES	Dr. Dana Tulegenova Assoc. Prof. Dr. Yerzhan Mukhammedov Aidana Kassenova

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HALL / SALON 5	**Assoc. Prof. Dr. Leyla Hasanova**	1	CRISPR-CAS9 MEDIATED GENE EDITING FOR DROUGHT RESISTANCE IN ROMANIAN WHEAT VARIETIES	Prof. Dr. Andrei Popescu Dr. Maria Ionescu Ioana Vasilescu
		2	EPIGENETIC MODIFICATIONS ASSOCIATED WITH CANCER PROGRESSION IN ROMANIAN POPULATIONS	Assoc. Prof. Dr. Radu Stanescu Elena Dragomir Mihai Popa
		3	NANOPARTICLE DELIVERY SYSTEMS FOR SIRNA THERAPEUTICS IN EGYPTIAN LIVER CANCER MODELS	Dr. Ahmed Khalil Fatima Salem Omar Hassan Prof. Dr. Nadia El-Gendy
		4	MITOCHONDRIAL DNA MUTATIONS LINKED TO METABOLIC DISORDERS IN EGYPTIAN COHORTS	Assoc. Prof. Dr. Karim Abdel Layla Mahmoud
		5	TELOMERE LENGTH VARIATIONS AND AGING PROCESSES IN AZERBAIJANI ELDERLY POPULATIONS	Dr. Elnur Mammadov Assoc. Prof. Dr. Leyla Hasanova Nigar Aliyeva
		6	NON-CODING RNA REGULATION OF GENE EXPRESSION IN AZERBAIJANI CARDIOVASCULAR PATIENTS	Prof. Dr. Kamal Huseynov Aysel Ibrahimova
		7	GENOME-WIDE ASSOCIATION STUDIES FOR DIABETES SUSCEPTIBILITY IN PAKISTANI POPULATIONS	Dr. Arif Khan Sana Malik Assoc. Prof. Dr. Bilal Ahmed Hina Gul
		8	MICRORNA BIOMARKERS FOR BREAST CANCER EARLY DETECTION IN PAKISTANI WOMEN	Prof. Dr. Faisal Rehman Zainab Noor
		9	PROTEIN-PROTEIN INTERACTION NETWORKS IN PAKISTANI LUNG CANCER PATHOGENESIS	Dr. Omar Siddiqui Rabia Saleem Muhammad Arif

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HALL / SALON 6	**D Assis. Prof. Dr. Nyoman Artawa**	1	PHYTOREMEDIATION POTENTIAL OF ROMANIAN DANUBE DELTA PLANTS FOR HEAVY METAL POLLUTION	Prof. Dr. Andrei Popescu Dr. Maria Ionescu Ioana Vasilescu
		2	MICROBIAL DIVERSITY IN CARPATHIAN CAVE ECOSYSTEMS AND THEIR BIOTECHNOLOGICAL APPLICATIONS	Assoc. Prof. Dr. Radu Stanescu Elena Dragomir Victor Popa
		3	CORAL BLEACHING RESISTANCE MECHANISMS IN INDONESIAN RAJA AMPAT MARINE PROTECTED AREAS	Dr. Sari Wijaya Budi Santoso Lina Pratiwi Dewi Kusuma I Made Setiawan
		4	GENETIC DIVERSITY ASSESSMENT OF SUMATRAN ORANGUTAN POPULATIONS USING NON-INVASIVE SAMPLING	Assis. Prof. Dr. Nyoman Artawa
		5	PHYTOCHEMICAL ANALYSIS OF PERSIAN GULF MANGROVE SPECIES FOR ANTICANCER ACTIVITY	Assoc. Prof. Dr. Reza Jalali Fatemeh Karim Mohammad Rezaei
		6	MICROPLASTIC INGESTION EFFECTS ON IRANIAN CASPIAN SEA FISH GUT MICROBIOMES	Dr. Soraya Mahmoudi Ali Hosseini
		7	CUBAN BIO-DIVERSITY CONSERVATION STRATEGIES FOR ENDANGERED AMPHIBIAN SPECIES	Prof. Dr. Carlos Rodriguez Dr. Ana Morales Luis Fernandez
		8	MOLECULAR EVOLUTION OF VIRUS-HOST INTERACTIONS IN CUBAN BAT RESERVOIRS	Assoc. Prof. Dr. Maria Gonzalez Pedro Alvarez Sofia Ramirez
		9	THERMOTOLERANT YEAST STRAINS FROM CUBAN HOT SPRINGS FOR BIOETHANOL PRODUCTION	Dr. Javier Lopez Yamilka Perez

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HALL / SALON 7	**Assoc. Prof. Dr. Budi Santoso**	1	INNOVATIVE STEM EDUCATION MODELS FOR RURAL NORTH MACEDONIAN PRIMARY SCHOOLS	Prof. Dr. Nikola Petrovski Elena Georgieva Stefan Dimitrov
		2	DIGITAL LITERACY PROGRAMS ADDRESSING GENDER GAPS IN MACEDONIAN SECONDARY EDUCATION	Assoc. Prof. Dr. Marija Ilievska Dr. Aleksandar Risteski Ana Kostovska
		3	CULTURALLY RESPONSIVE TEACHING STRATEGIES IN INDONESIAN MULTILINGUAL CLASSROOMS	Assoc. Prof. Dr. Budi Santoso Dr. Sari Wijaya
		4	INTEGRATING TRADITIONAL WAYANG ARTS INTO INDONESIAN PRIMARY CURRICULUM	Assoc. Prof. Dr. Nyoman Suryani Iwan Pratama Dewi Lestari
		5	CHALLENGES OF REMOTE LEARNING IMPLEMENTATION IN IRANIAN RURAL DISTRICTS	Dr. Reza Ahmadi Fatemeh Karimi
		6	TEACHER TRAINING PROGRAMS FOR INCLUSIVE EDUCATION IN IRANIAN SPECIAL NEEDS SCHOOLS	Leila Hosseini Prof. Dr. Hassan Jafari Mohammad Rezaei
		7	CUBAN LITERACY CAMPAIGN MODELS ADAPTED FOR ADULT EDUCATION IN REMOTE AREAS	Assoc. Prof. Dr. Carlos Rodriguez Dr. Maria Gonzalez
		8	MUSIC EDUCATION AS SOCIAL MOBILITY TOOL IN CUBAN URBAN COMMUNITIES	Prof. Dr. Ana Morales Dr. Luis Fernandez Sofia Ramirez

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HALL / SALON 8	**Assoc. Prof. Dr. Elara Hoxha**	1	PERSONALIZED LEARNING PATHWAYS USING AI ADAPTIVE ALGORITHMS IN INDONESIAN VOCATIONAL HIGH SCHOOLS	Prof. Dr. Budi Santoso Dr. Sari Wijaya Lina Pratiwi I Made Artawa
		2	AI-DRIVEN LANGUAGE ACQUISITION TOOLS FOR REMOTE INDONESIAN RURAL STUDENTS	Assoc. Prof. Dr. Nyoman Sujana Dewi Ratna Agus Setiawan
		3	DEVELOPING AI CHATBOTS FOR MATHEMATICS TUTORING IN INDIAN RURAL GOVERNMENT SCHOOLS	Dr. Priya Sharma Vikram Joshi Kavya Nair
		4	MACHINE LEARNING MODELS FOR PREDICTING STUDENT DROPOUT RATES IN HIGHER EDUCATION	Prof. Dr. Arjun Mehra Divya Reddy
		5	AI-POWERED ASSESSMENT SYSTEMS FOR ALBANIAN PRIMARY EDUCATION CURRICULUM	Assoc. Prof. Dr. Elara Hoxha Besnik Leka Mira Deda
		6	VIRTUAL REALITY SIMULATIONS ENHANCED BY AI FOR VOCATIONAL TRAINING IN ALBANIA	Dr. Alban Kreci Elona Meta
		7	NATURAL LANGUAGE PROCESSING FOR ARABIC LANGUAGE TEACHING IN QATARI INTERNATIONAL SCHOOLS	Prof. Dr. Khalid Al-Thani Fatima Al-Mansoori Noor Salem

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HALL / SALON 9	**Assoc. Prof. Dr. Enea Lika**	1	PHYTOREMEDIATION POTENTIAL OF INDONESIAN TROPICAL PLANTS FOR HEAVY METAL SOIL CONTAMINATION	Dr. Sari Wijaya Lina Pratiwi I Made Artawa
		2	MICROBIAL DIVERSITY IN INDONESIAN RICE PADDY SOILS UNDER ORGANIC FARMING PRACTICES	Assoc. Prof. Dr. Nyoman Sujana Dewi Ratna Agus Setiawan
		3	SOIL EROSION MODELING AND CONSERVATION STRATEGIES IN HIMALAYAN AGRICULTURAL LANDSCAPES	Dr. Arjun Patel Priya Sharma Rohan Mehra
		4	BIOCHAR APPLICATION EFFECTS ON SOIL FERTILITY IN SEMI-ARID INDIAN CROPPING SYSTEMS	Prof. Dr. Vikram Singh Assis. Pro. Dr. Neha Gupta Sanjay Patel Mirela Deda Erion Hoxha
		5	ORGANIC AMENDMENTS IMPACT ON SOIL MICROBIAL ACTIVITY IN ALBANIAN MEDITERRANEAN OLIVE GROVES	Assoc. Prof. Dr. Enea Lika
		6	CLIMATE CHANGE EFFECTS ON ALBANIAN MOUNTAIN SOIL CARBON SEQUESTRATION POTENTIAL	Dr. Liridon Kuci Anila Meta Flamur Bega
		7	SALINE SOIL RECLAMATION TECHNIQUES USING HALOPHYTES IN QATARI ARID ECOSYSTEMS	Prof. Dr. Khalid Al-Mansoori Fatima Hassan Noor Salem
		8	DUNE STABILIZATION AND SOIL CONSERVATION STRATEGIES FOR QATARI COASTAL AGRICULTURE	Assoc. Prof. Dr. Omar Al-Fahim Sara Al-Ketbi

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HALL / SALON 10	**Assoc. Prof. Dr. Yerzhan Bekbolatov**	1	INNOVATIVE LANGUAGE ACQUISITION METHODS FOR BILINGUAL CHILDREN IN ALGERIAN PRIMARY SCHOOLS	Karim Zahir Fatima Lounis Prof. Dr. Amina Belkacem Samir Boualem
		2	STEM EDUCATION INTEGRATION THROUGH PLAY-BASED LEARNING IN RURAL ALGERIAN COMMUNITIES	Assoc. Prof. Dr. Yacine Hadrami Nadia Cherif
		3	DIGITAL LITERACY DEVELOPMENT FOR UNDERPRIVILEGED CHILDREN IN INDIAN URBAN SLUMS	Dr. Priya Sharma Prof. Dr. Arjun Mehra Kavya Nair
		4	CULTURAL HERITAGE PRESERVATION THROUGH STORYTELLING IN INDIAN PRESCHOOL CURRICULA	Assoc. Prof. Dr. Vikrant Singh Pooja Desai
		5	MATHEMATICS ANXIETY REDUCTION STRATEGIES FOR KAZAKHSTANI MIDDLE SCHOOL STUDENTS	Dr. Aigerim Tolegenova Nursultan Abayev Dana Kairatova
		6	INCLUSIVE EDUCATION MODELS FOR CHILDREN WITH SPECIAL NEEDS IN KAZAKHSTAN	Assoc. Prof. Dr. Yerzhan Bekbolatov Aidana Sarsenova Ruslan Zhumatov
		7	CREATIVE ARTS THERAPY FOR EMOTIONAL DEVELOPMENT IN GREEK PRIMARY EDUCATION	Prof. Dr. Eleni Papadopoulos Dr. Nikos Karamanlis
		8	PHILOSOPHICAL INQUIRY METHODS IN GREEK EARLY CHILDHOOD CLASSROOM DISCUSSIONS	Assoc. Prof. Dr. Dimitri Stavros Maria Kostas

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HALL / SALON 1	**Dr. Öğr. Üyesi GÖZDE KARABULUT**	1	IN VITRO ANTIOXIDANT ACTIVITY OF METHANOLIC EXTRACT OBTAINED FROM CITRULLUS LANATUS ((THUNB.) MATSUM. & NAKAI) (WATERMELON) FRUIT	Graduate student, Zeynep SEVİM Dr. Figen ERDEM ERİŞİR Prof. Dr. Ökkeş YILMAZ
		2	INVESTIGATION OF THE CYTOTOXICITY OF GEASTRUM FIMBRIATUM AND GEASTRUM RUFESCENS SPECIES	Gizem GENÇ Nurdan SARAÇ
		3	YENİ NESİL ÇEVRESEL KİRLETİCİ 6PPD-KİNON'UN PANKREATİK BETA HÜCRELERİNDE (INS-1) OLUŞTURDUĞU SİTOTOKSİK VE FONKSİYONEL HASARIN *İN VİTRO* DEĞERLENDİRİLMESİ	Dr. Öğr. Üyesi GÖZDE KARABULUT
		4	*Escherichia coli*'DE *cbpA* GENİNİN FENOLİK ASİT TOLERANSINDAKİ ROLÜ: MUTANT VE KOMPLEMENTASYON ANALİZİNDEN KANITLAR	KADRİYE ASLIHAN ONAT TAŞDELEN HATİCE ÖZTÜRKEL KABAKAŞ Dr. Öğr. Gör. MERVE SEZER KÜRKÇÜ Doç. Dr. BEKİR ÇÖL
		5	DIFFERENTIAL TRANSCRIPTIONAL RESPONSE OF THE yrbF (mlaF) GENE TO STRUCTURALLY RELATED PHENOLIC ACIDS IN ESCHERICHIA COLI	Öğr. Gör. Dr., Merve SEZER KÜRKÇÜ Hatice ÖZTÜRKEL KABAKAŞ Kadriye Aslıhan ONAT TAŞDELEN Dr. Öğr. Üyesi, Esra DİBEK Prof. Dr., Bekir ÇÖL
		6	THE MULTIFACETED EFFECTS OF PROBIOTICS ON HEALTH: A CURRENT ASSESSMENT OF IMMUNE REGULATION, INFLAMMATION SUPPRESSION, AND ANTICANCER POTENTIAL	Dr. Sümeyye AKBULUT
		7	DETERMINATION OF ANTICANCER ACTIVITY AND BIOCOMPATIBILITY OF COMMERCIAL AND SYNTHESIZED PLA-PEG-PLA BLOCK COPOLYMERS	Assistant Prof Asli KARA Professor Dursun Ali KOSE Professor Gulcin Alp AVCI Professor Emre AVCI

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HALL / SALON 2	**Doç. Dr. AYSEL ARSLAN**	1	HUMANISTIC PERSPECTIVES IN THE MODERN YEMENI NOVEL: THE CASE OF AHMED QĀSIM ʿALĪ AL-ʿARĪQĪ	Doç. Dr. RIFAT AKBAŞ
		2	EMİNE ŞENLİKOĞLU'NUN MARİA ROMANINI HİDAYET ROMANI OLARAK OKUMAK	Dr., Batuhan ŞUORUÇ
		3	İLAHİ FEYİZDEN SÜHANA: CEVRÎ DİVANI'NDA ŞİİR VE ŞAİRLİK	Doçent, MURAT KEKLİK
		4	LINGUISTIC DISCRIMINATION AND EDUCATIONAL INEQUALITY	Nadezda ERYILDIZ, M. A. (FU Berlin)
		5	SOCIAL APHASIA: PANOPTICON AND NEWSPEAK PERSPECTIVES – AN ANALYSIS OF THE NOVEL 1984	Doç. Dr. AYSEL ARSLAN
		6	FROM INDIVIDUAL LONELINESS TO COLLECTIVE UNREST: AN ONTOLOGICAL ANALYSIS OF ASOCIALITY AND SOCIAL MELANCHOLIA IN THE SORROWS OF YOUNG WERTHER	Doç. Dr. AYSEL ARSLAN
		7	THE IMAGE OF MIRZA ALAKBAR SABIR IN THE HISTORICAL NOVEL "SABIR" BY AZIZA JAFARZADEH	SEVİNJ MİRZAYEVA
		8	ERZURUM AĞZI ÖRNEKLEMİNDE MİZAH	Yüksek Lisans Öğrencisi Selim ARSLAN

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HALL / SALON 3	**Assoc. Prof. TUFAN İNALTEKİN**	1	CONTENT ANALYSIS OF ARTICLES ON READABILITY IN TURKISH LANGUAGE EDUCATION: 2000-2023	Master's Student, Göksel ÇAĞLAR Assistant Professor, Erhan ÇAPOĞLU
		2	AN ANALYSİS OF ABDURRAHİM KARAKOÇ'S POEMS "DAVA ŞİİRLERİ " AND "HASAN'A MEKTUPLAR" ACCORDİNG TO THE VİRTUE-VALUE-ACTİON MODEL	HİLAL PENPE Dr. Öğretim Üyesi , ERHAN ÇAPOĞLU
		3	FEN BİLGİSİ ÖĞRETMEN ADAYLARININ YAPAY ZEKA PROGRAMI GEMİNİ İLE YAPTIKLARI DİJİTAL MATERYALLERİN DEĞERLENDİRİLMESİ	Alper SAKİN Prof. Dr. Güldem DÖNEL AKGÜL Zeynep YALÇIN Meryem YETKİN
		4	DİJİTAL İÇERİKLER FEN BİLGİSİ DERS KİTAPLARINDA NASIL KULLANILMIŞTIR?	Alper SAKİN Prof. Dr. Güldem DÖNEL AKGÜL Zeynep YALÇIN Meryem YETKİN
		5	AN ANALYSIS OF THE '365-DAY STORY SERIES' IN TERMS OF VALUES	Master's Student, Pınar CUDA Assistant Professor, Erhan ÇAPOĞLU
		6	ORTAOKUL ÖĞRENCİLERİNİN AFET BİLİNCİ FARKINDALIK DÜZEYLERİNİN DEMOGRAFİK DEĞİŞKENLER AÇISINDAN İNCELENMESİ	Yüksek Lisans Öğrencisi, HANİFİ KARATAŞ Prof. Dr., MUSTAFA ÖZTÜRK
		7	AN EXAMINATION OF 8TH GRADE STUDENTS' UNDERSTANDING OF THE SHAPES OF THE EARTH AND THE MOON	Asst. Prof. TOLGA SAKA Assoc. Prof. TUFAN İNALTEKİN

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HALL / SALON 4	**Prof. Dr. Aynur AYTEKİN ÖZDEMİR**	1	PEDİATRİK HASTALARDA GÖĞÜS TÜPÜ ÇIKARMA İŞLEMİNDE AĞRI YÖNETİMİ: HEMŞİRELİK YAKLAŞIMLARINA YÖNELİK BİR DERLEME	Uzm. Hemşire Gamze DURAN KÜÇÜK Prof. Dr. Aynur AYTEKİN ÖZDEMİR
		2	YENİDOĞAN YOĞUN BAKIM ÜNİTELERİNDE EMZİRMENİN GÜÇLENDİRİLMESİNDE KANITA DAYALI BİR BAKIŞ: MOTİVASYONEL GÖRÜŞME	Arş. Gör. Esma ÜNAL AKTAŞ Prof. Dr. Aynur AYTEKİN ÖZDEMİR
		3	MOBİL SAĞLIK UYGULAMALARININ BARİATRİK CERRAHİ SONRASI HASTA SONUÇLARI ÜZERİNDEKİ ETKİSİ	Dr. Beyzanur KIZILOĞLU AĞGÜL
		4	REPRODUCTIVE HEALTH AND NURSING ROLES IN WOMEN EXPOSED TO DOMESTIC VIOLENCE	Lecturer. Dr., ZELİHA TURAN
		5	GÖÇMEN VE MÜLTECİ KADINLARDA GEBELİK/DOĞUM HİZMETLERİNE ERİŞİM: SORUNLAR VE ÇÖZÜM ÖNERİLERİ	Öğrenci, AMİRA KARİM Arş. Gör. Dr. ÇİĞDEM ŞEN TEPE

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HALL / SALON 5	**Assist. Prof. Dr., Aysel YAVUZ**	1	URBAN PLANNING APPROACHES ACCORDING TO CLIMATE SCENARIOS	Arş. Gör. Dr., SEYHAN SEYHAN Prof. Dr., ELİF BAYRAMOĞLU Prof. Dr., BANU ÇİÇEK KURDOĞLU
		2	CLIMATE-ADAPTIVE PLAYGROUND DESIGN CRITERIA FOR URBAN PARKS	Arş. Gör. Dr., SEYHAN SEYHAN Prof. Dr., ELİF BAYRAMOĞLU Prof. Dr., BANU ÇİÇEK KURDOĞLU
		3	BİTKİSEL TASARIMDA ENTROPİ: ANALOJİK BİR YAKLAŞIM	Dr. Sinem KIZILASLAN
		4	KENTSEL DİRENÇLİLİK BAĞLAMINDA YEŞİL ALANLARIN ÇOK BOYUTLU İŞLEVLERİNİN DEĞERLENDİRİLMESİ	Arş. Gör., Rıdvan TİK Doç. Dr., Tuncay KAYA
		5	SÜRDÜRÜLEBİLİR PEYZAJ YÖNETİMİNDE ÇİM ATIKLARININ MALÇ OLARAK DEĞERLENDİRİLMESİ VE SU VERİMLİLİĞİNE ETKİSİ	Arş. Gör., RIDVAN TİK Doç. Dr., TUNCAY KAYA
		6	STREETS AS PLAY SPACES FOR CHILDREN	Prof. Dr., Habibe ACAR Dr. Öğr. Üyesi, Aysel YAVUZ Prof. Dr., Hilal TURGUT
		7	FROM FORM TO FLOW: SOCIAL LANDSCAPES AS GENERATORS OF PHYSICAL ACTIVITY IN CONTEMPORARY URBAN PARKS	Assist. Prof. Dr., Aysel YAVUZ Prof. Dr., Habibe ACAR Prof. Dr., Hilal TURGUT
		8	THE EFFECTS OF PERIPHERY FORMATION ON THE LANDSCAPE: THE TRABZON YOMRA-KAŞÜSTÜ EXAMPLE	Dr.Öğr. Üyesi Duygu AKYOL KUYUMCUOĞLU Prof.Dr. Sema MUMCU

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HALL / SALON 6	**Doç. Dr. Necattin HANAY**	1	SCIENTIFIC PROGRESS AND THE TRANSFORMATION OF RATIONALITY IN THE HISTORY OF SCIENCE: BACHELARD'S DIALECTICAL APPROACH BETWEEN DISCONTINUITY AND CUMULATIVISM	R.A. Dr. Ömer Faruk Karaköse
		2	ANTAKYALI BİR MUHADDİS: EBU SEHL HEYSEM b. CEMİL- İLMİ KİŞİLİĞİ VE HADİS İLMİNDEKİ YERİ	Öğr.Gör. Dr., Ahmet Emre AYDINLI
		3	CERH VE TA'DÎL LİTERATÜRÜNDE "ŞEYH" KAVRAMININ KULLANIM FORMLARI	Yüksek Lisans Öğrencisi, Şeyma ŞEKER Prof. Dr., Sezai ENGİN
		4	THE RELATIONSHIP BETWEEN THE QUR'AN, REASON, AND SCIENCE IN ʿABBĀS MAḤMŪD AL-ʿAQQĀD'S AL-FALSAFAH AL-QURʾĀNIYYAH: AN ISSUE-CENTERED MODE OF INTERPRETATION	Doç. Dr. Necattin HANAY
		5	ÖLÜM KORKUSUNDAN ÖLÜMSÜZLÜK TASARIMINA: TRANSHÜMANİZM VE VAROLUŞUN YENİDEN İNŞASI	Zeynep Kaya Dr. Öğr. Mustafa Dikmen
		6	"SEÇİLMİŞ AİLE" TASAVVURUNUN ARKEOLOJİSİ: ANTİK MISIR VE AİLE FENOMENOLOJİSİ	Funda Nur Ünlü Prof.Dr. Şevket Yavuz

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HALL / SALON 7	**Dr. Ülkü Koçak**	1	THE PROBLEM OF TARQĪQ–IMĀLA RELATIONSHIP IN THE SCIENCE OF QIRĀʾĀT: CONCEPTUAL ANALYSIS AND REFLECTIONS IN PRACTICE	Dr, RESUL AKCAN
		2	QUR'ANIC RECITATION IN THE DIGITAL AGE: THE POPULARIZING AND TRANSFORMATIVE EFFECTS OF SOCIAL MEDIA PLATFORMS	Asist. Prof., İHSAN SÜTŞURUP
		3	THE SPİRİTUAL MOTİVATİONS OF THE COMPANİONS İN LEARNİNG THE QUR'AN	Dr. Öğretim Üyesi, KENAN AKLAN
		4	ANADOLU'NUN MANEVİ COĞRAFYASINDA BİR DURAK HAYDARDEDE TÜRBESİ	Yüksek Lisans Öğrencisi, ADEM TAŞKİN
		5	THE METHODOLOGY, SOURCES, AND SİGNİFİCANCE AS A SOURCE OF UNDERSTANDİNG THE QUR'ĀN: A CASE STUDY OF IBN QUTAYBA'S TA'WĪL MUSHKİL AL-QUR'ĀN	Master's student, ABDURRAHMAN ENES ATAKUL Assoc. Dr., MURAT BAHAR
		6	FITRAH AND BELIEF IN GOD: A COMPARISON BETWEEN ISLAMIC THOUGHT AND CONTEMPORARY PHILOSOPHY OF RELIGION	Dr. Ülkü Koçak

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HALL / SALON 1	**Assis. Prof. Dr. Elena Bucataru**	1	THE ECUMENICAL DIALOGUE BETWEEN ORTHODOX AND CATHOLIC TRADITIONS IN CONTEMPORARY MOLDOVA	Prof. Dr. Ion Crețu
		2	THEOLOGICAL IMPLICATIONS OF SECULARIZATION ON MOLDOVAN ORTHODOX SPIRITUALITY	Assis. Prof. Dr. Elena Bucataru Victor Rusu Petru Lupașcu Ana Maria Popescu
		3	INTERFAITH DIALOGUE BETWEEN CONFUCIANISM AND CHRISTIANITY IN MODERN TAIWANESE SOCIETY -yu	Dr. Li Wei-min Chen Yi-ling Wang Hsiao Tsai Chun-hsiung
		4	TAOIST INFLUENCES ON CONTEMPORARY TAIWANESE CHRISTIAN LITURGICAL PRACTICES	Dr. Huang Mei-ling
		5	ISLAMIC REVIVALISM AND NATIONAL IDENTITY FORMATION IN SECULAR KYRGYZSTAN	Assoc. Prof. Dr. Almazbek Asanov Gulnara Ibraimova Nurbol Otorbayev
		6	CHRISTIAN MISSIONARY ACTIVITIES AMID CENTRAL ASIAN ISLAMIC TRADITIONS	Dr. Jamilya Toktogulova Eldar Kaparov
		7	INTERRELIGIOUS COEXISTENCE MODELS IN DUBAI'S MULTICULTURAL URBAN CONTEXT	Prof. Dr. Ahmed Al-Mansoori Fatima Khalil Omar Saeed
		8	SUFI MYSTICISM AND CONTEMPORARY SPIRITUALITY IN EMIRATI MUSLIM COMMUNITIES	Assoc. Prof. Dr. Layla Al-Hashimi Khalid Rahman

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HALL / SALON 2	**Assoc. Prof. Dr. Reza Jalali**	1	THE ROLE OF ETHIOPIAN ORTHODOX THEOLOGY IN SHAPING CONTEMPORARY AFRICAN CHRISTIAN IDENTITY	Assis. Prof. Dr. Mikael Tesfaye Dr. Selamawit Gebre Abraham Kebede
		2	ESCHATOLOGICAL INTERPRETATIONS IN ETHIOPIAN GE'EZ LITURGICAL TEXTS AND THEIR MODERN IMPLICATIONS	Assoc. Prof. Dr. Helen Assefa Yonas Berhanu Dawit Alemayehu
		3	MARIAN DEVOTION IN LEBANESE MARONITE THEOLOGY AND INTERFAITH DIALOGUE	Dr. Elias Khoury Prof. Dr. Nadia Rahme
		4	SHIITE-SUNNI ECUMENICAL DIALOGUE INITIATIVES IN CONTEMPORARY LEBANESE THEOLOGY	Fr. Antoine Sarkis Assoc. Prof. Dr. Layla Haddad
		5	ISLAMIC ESCHATOLOGY AND ENVIRONMENTAL ETHICS IN PAKISTANI MUSLIM SCHOLARSHIP	Prof. Dr. Imran Qureshi Dr. Amina Siddiqui
		6	QURANIC HERMENEUTICS AND GENDER ROLES IN PAKISTANI REFORMIST THEOLOGY	Assoc. Prof. Dr. Hassan Raza Sadia Mahmood
		7	SHIITE IMMAMOLOGY AND POLITICAL AUTHORITY IN CONTEMPORARY IRANIAN THOUGHT	Prof. Dr. Ali Rezaei Dr. Fatima Hosseini Mehdi Karimi
		8	MYSTICAL INTERPRETATIONS OF SUFISM IN PERSIAN POETIC THEOLOGY	Assoc. Prof. Dr. Reza Jalali

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HALL / SALON 3	**Assoc. Prof. Dr. Fatima Zubairu**	1	AFRICAN INDIGENOUS SPIRITUALITY AND CHRISTIAN THEOLOGICAL SYNCRETISM IN CONTEMPORARY WORSHIP PRACTICES	Samuel Osei Dr. Kwame Nkosi Dr. Aisha Mwangi
		2	ISLAMIC ESCHATOLOGY INTERPRETATIONS THROUGH AFRICAN ORAL TRADITION LENSES	Assoc. Prof. Dr. Fatima Zubairu Elias Kofi
		3	SUFI MYSTICISM AND PHILOSOPHICAL EXISTENTIALISM IN MOROCCAN MALIKI SCHOLARSHIP	Dr. Nadia Belkacem Karim Zahir Dr. Ahmed Laraki
		4	IBN RUSHD'S RATIONALISM VERSUS AL-GHAZZALI'S INTUITIONISM IN MOROCCAN THEOLOGICAL DISCOURSE	Assoc. Prof. Dr. Fatima Jaber Youssef Hadrami
		5	AUGUSTINIAN GRACE THEOLOGY ADAPTATIONS IN TUNISIAN POST-COLONIAL CHRISTIAN THOUGHT	Dr. Sami Kallel Leila Trabelsi Prof. Dr. Hedi Ben Salem
		6	IBN ARABI'S UNITY OF BEING DOCTRINE IN CONTEMPORARY TUNISIAN SUFI PHILOSOPHY	Assoc. Prof. Dr. Moncef Bouazizi
		7	ORTHODOX HESYCHASM AND MACEDONIAN FOLK SPIRITUALITY INTERSECTIONS	Dr. Elena Risteska Prof. Dr. Nikola Petrovski
		8	BYZANTINE PALAMISM INFLUENCES ON MACEDONIAN THEOLOGICAL ANTHROPOLOGY	Assoc. Prof. Dr. Goran Trajkovski Marija Angelova

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HALL / SALON 4	**Assoc. Prof. Dr. Nadia Cherkaoui**	1	TELEHEALTH IMPLEMENTATION CHALLENGES FOR RURAL MATERNAL HEALTHCARE IN SUB-SAHARAN AFRICA	Prof. Dr. Amina Kone Dr. Samuel Mwangi Fatou Diop Kwame Asante
		2	PAIN MANAGEMENT PROTOCOLS FOR POSTOPERATIVE PATIENTS IN NIGERIAN PUBLIC HOSPITALS	Assoc. Prof. Dr. Ngozi Okeke Dr. Yusuf Bello Chiamaka Nwosu
		3	NURSE-LED DIABETES EDUCATION PROGRAMS FOR URBAN MOROCCAN DIABETIC PATIENTS	Prof. Dr. Fatima Zahra El Amrani Dr. Karim Benali Aicha Lahlou
		4	MENTAL HEALTH SUPPORT STRATEGIES FOR COVID-19 FRONTLINE NURSES IN MOROCCO	Assoc. Prof. Dr. Nadia Cherkaoui Youssef Idrissi Soukaina Mezouar
		5	PEDIATRIC NURSING INTERVENTIONS FOR RESPIRATORY INFECTIONS IN TUNISIAN CHILDREN	Dr. Lamia Ben Salem Assoc. Prof. Dr. Hassen Trabelsi Meriem Jrad Amel Kefi
		6	WOUND CARE MANAGEMENT TRAINING EFFECTS ON NURSE COMPETENCY IN TUNISIAN HOSPITALS	Prof. Dr. Moncef Zghal Dr. Nadia Bouaziz Sahar Ghrabi
		7	ELDERLY CARE MODELS AND FALL PREVENTION STRATEGIES IN NORTH MACEDONIAN NURSING HOMES	Assoc. Prof. Dr. Elena Petrovska Dr. Nikola Trajkovski Marija Angelova Ivan Kostovski
		8	CHRONIC DISEASE MANAGEMENT THROUGH COMMUNITY NURSING IN MACEDONIAN RURAL AREAS	Prof. Dr. Goran Popovski Dr. Biljana Risteska Tanja Milevska

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HALL / SALON 5	**Assoc. Prof. Dr. Chen Hui Min**	1	MATERNAL NUTRITIONAL INTERVENTIONS IMPROVING FETAL BRAIN DEVELOPMENT OUTCOMES IN SINGAPORE	Prof. Dr. Lim Mei Ling Dr. Tan Wei Jie Sarah Ng
		2	TELEMEDICINE APPLICATIONS FOR HIGH-RISK PREGNANCY MONITORING IN URBAN SINGAPORE	Assoc. Prof. Dr. Chen Hui Min Dr. Rajesh Kumar Emily Wong
		3	GESTATIONAL DIABETES MANAGEMENT PROTOCOLS USING AI PREDICTIVE ANALYTICS IN CHINESE POPULATIONS	Prof. Dr. Zhang Wei Dr. Li Xiaoyan Wang Jun
		4	TRADITIONAL CHINESE MEDICINE INTEGRATION IN PRENATAL CARE FOR POSTPARTUM RECOVERY	Dr. Liu Mei Assoc. Prof. Chen Li
		5	PREVENTING MATERNAL MORTALITY THROUGH COMMUNITY HEALTH WORKER PROGRAMS IN RURAL TANZANIA	Prof. Dr. Amina Juma Dr. Elias Kweka Fatuma Ally
		6	NUTRITIONAL DEFICIENCY SCREENING AND INTERVENTIONS FOR PREGNANT WOMEN IN TANZANIAN REFUGEE CAMPS	Dr. Zawadi Mushi Joseph Njoroge
		7	PRENATAL CARE ACCESS IMPROVEMENT MODELS FOR RURAL WOMEN IN AZERBAIJAN	Prof. Dr. Leyla Hasanova Dr. Elnur Aliyev Nigar Mammadova
			MATERNAL MENTAL HEALTH SUPPORT SYSTEMS DURING PREGNANCY IN AZERBAIJANI CITIES	Assoc. Prof. Dr. Aysel Gurbanova Kamran Ibrahimov
		8	FETAL ULTRASOUND SCREENING EFFECTIVENESS FOR CONGENITAL ANOMALY DETECTION IN AZERBAIJAN	Dr. Sevinc Nuriyeva Farid Hasanov Zara Karimova

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HALL / SALON 6	**Assoc. Prof. Dr. Maria Rusu**	1	TELEMEDICINE IMPLEMENTATION STRATEGIES FOR CHRONIC DISEASE MANAGEMENT IN SINGAPORE'S AGING POPULATION	Prof. Dr. Lim Wei Ming Dr. Tan Siew Ling Assoc. Prof. Dr. Ng Hui Fen
		2	MENTAL HEALTH INTERVENTIONS TARGETING WORKPLACE STRESS AMONG SINGAPOREAN HEALTHCARE WORKERS	Dr. Chloe Tan Rachel Lim Prof. Dr. Benjamin Goh
		3	NUTRITIONAL DEFICIENCY PREVENTION PROGRAMS IN RURAL MOLDOVAN COMMUNITIES	Assoc. Prof. Dr. Maria Rusu Ion Popa
		4	MATERNAL HEALTHCARE ACCESS IMPROVEMENT INITIATIVES IN MOLDOVA	Dr. Elena Cebotari Victor Lupascu Natalia Dragancea
		5	MALARIA VECTOR CONTROL STRATEGIES IN TANZANIAN COASTAL REGIONS	Prof. Dr. Juma Kilonzo Dr. Amina Mwamba
		6	COMMUNITY-BASED TUBERCULOSIS SCREENING PROGRAMS IN RURAL TANZANIA	Assoc. Prof. Dr. Elias Nkya Fatuma Juma Dr. Zuberi Mushi
		7	DIABETES PREVALENCE AND MANAGEMENT CHALLENGES IN ALGERIAN URBAN POPULATIONS	Prof. Dr. Karim Belhocine Dr. Nadia Zerhouni Yacine Amrane
			MENTAL HEALTH STIGMA REDUCTION CAMPAIGNS IN ALGERIAN SCHOOL COMMUNITIES	Assoc. Prof. Dr. Samir Lounis
		8	CARDIOVASCULAR DISEASE PREVENTION THROUGH COMMUNITY EDUCATION IN ALGERIA	Dr. Amina Hadji Mehdi Bouziane Prof. Dr. Zahra Bendaoud

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HALL / SALON 7	**Assoc. Prof. Dr. Anjali Desai**	1	EPIDEMIOLOGICAL PATTERNS OF DIABETES MELLITUS IN URBAN INDIAN POPULATIONS WITH SOCIOECONOMIC DISPARITIES	Prof. Dr. Rajesh Kumar Dr. Priya Sharma Vikram Singh
		2	MATERNAL HEALTH OUTCOMES AND NUTRITIONAL INTERVENTIONS IN RURAL INDIAN TRIBAL COMMUNITIES	Assoc. Prof. Dr. Anjali Desai Neha Patel Sanjay Mehta
		3	ADVANCES IN TELEMEDICINE FOR CARDIOVASCULAR DISEASE MANAGEMENT IN TAIWANESE ELDERLY	Dr. Wei-Ling Chen Hui-Ju Lin Prof. Dr. Ming-Hsien Tsai
		4	NEURODEGENERATIVE DISEASE PREVENTION STRATEGIES THROUGH TRADITIONAL TAIWANESE MEDICINE	Assoc. Prof. Dr. Li-Chun Wang Kuan-Yu Huang
		5	COMMUNITY HEALTH WORKER PROGRAMS FOR INFECTIOUS DISEASE CONTROL IN CUBAN RURAL AREAS	Dr. Carlos Rodriguez Maria Gonzalez Prof. Dr. Ana Morales Juan Perez
		6	BIOTECHNOLOGICAL APPROACHES TO DENGUE FEVER VACCINE DEVELOPMENT IN CUBA	Assoc. Prof. Dr. Luis Fernandez Elena Castro
		7	MALARIA ELIMINATION STRATEGIES AND VECTOR CONTROL IN NIGERIAN NORTHERN REGIONS	Fatima Yusuf Dr. Kabir Ibrahim
		8	MENTAL HEALTH INTEGRATION IN PRIMARY CARE SYSTEMS ACROSS NIGERIAN URBAN CENTERS	Assoc. Prof. Dr. Ngozi Okonkwo Chinedu Eze
		9	NON-COMMUNICABLE DISEASE SCREENING INITIATIVES IN NIGERIAN INFORMAL SETTLEMENTS	Dr. Aisha Mohammed Tunde Adebayo Rahma Ali

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HALL / SALON 8	**Dr. Sofia Vargas**	1	POSTCOLONIAL THEMES IN SALMAN RUSHDIE'S MIDNIGHT'S CHILDREN: HYBRIDITY AND NATIONAL IDENTITY	Prof. Dr. Aruna Sen Dr. Vikram Joshi Priya Mehta Rohan Desai Anjali Reddy
		2	FEMINIST RE-READINGS OF MYTHICAL NARRATIVES IN CONTEMPORARY INDIAN WOMEN NOVELISTS	Assoc. Prof. Dr. Kavya Nair
		3	LINGUISTIC LANDSCAPE ANALYSIS OF TAIPEI METRO STATIONS: MULTILINGUALISM AND IDENTITY	Dr. Wei-Ling Chen Hsin-Yi Lin
		4	TAIWANESE LITERATURE UNDER JAPANESE COLONIAL RULE: RESISTANCE THROUGH FOLK POETRY	Prof. Dr. Ming-Hsuan Wu Yi-Ting Chang
		5	AFRO-CUBAN ORAL TRADITIONS IN NICOLÁS GUILLÉN'S POETRY: RHYTHM AND RESISTANCE	Assoc. Prof. Dr. Carlos Rodríguez Mercedes López
		6	MAGICAL REALISM IN ALEJO CARPENTIER'S WORKS: THE BAROQUE CHRONOTOPE OF THE CARIBBEAN	Dr. Sofia Vargas Raúl Mendoza
		7	POSTCOLONIAL ECOCRITICISM IN CHINUA ACHEBE'S ARROW OF GOD: LAND AND LANGUAGE	Dr. Ngozi Okonkwo Dr. Emeka Nwosu
		8	ORAL PERFORMANCE POETRY IN CONTEMPORARY NIGERIAN SPOKEN WORD ARTISTRY	Assoc. Prof. Dr. Fatima Yusuf Adebayo Adewale
		9	GENDER DYNAMICS IN NIGERIAN YOUNG ADULT LITERATURE: VOICES FROM THE MARGINS	Dr. Chioma Eze Ibrahim Musa Blessing Okafor

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HALL / SALON 9	**Assoc. Prof. Dr. Nadia Belghiti**	1	POSTCOLONIAL THEMES IN CONTEMPORARY MOROCCAN FRANCOPHONE LITERATURE	Prof. Dr. Amina El-Khatib Dr. Karim Zahid Fatima Larboui
		2	LINGUISTIC HYBRIDITY IN MOROCCAN ARABIC DIALECT AND FRENCH LITERARY EXPRESSION	Assoc. Prof. Dr. Nadia Belghiti Youssef Amrani Leila Hadrami
		3	HOMER'S ODYSSEY REINTERPRETATIONS IN MODERN GREEK POETRY	Dr. Eleni Stavros Prof. Dr. Nikos Papadakis
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BIFURCATION ANALYSIS AND CHAOS CONTROL IN A NONSTANDARD DISCRETIZED POPULATION MODEL

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ABSTRACT

Understanding how external species input reshapes the long-term behavior of predator-prey interactions remains a fundamental challenge in mathematical ecology. This study addresses this question by examining a Leslie-Gower predator-prey system augmented with a constant prey immigration term, which models real-world phenomena including fish stocking and inter-habitat migration. To discretize the continuous model while retaining its essential biological properties such as positivity and boundedness, a nonstandard finite difference (NSFD) approach is employed. A complete stability classification of the unique positive coexistence equilibrium is established, and two distinct routes to complex dynamics are identified: a period-doubling (Flip) bifurcation, which initiates a cascade toward chaos as the predator growth parameter decreases through a critical value, and a Neimark-Sacker bifurcation, through which quasi-periodic oscillations emerge on an invariant closed curve as the same parameter increases beyond a second threshold. The direction and stability of each bifurcation are rigorously classified via center manifold reduction and Lyapunov coefficient computations. Two complementary control strategies, namely state feedback and hybrid control, are designed to steer chaotic trajectories back to the coexistence equilibrium, and the corresponding stability domains are explicitly determined. A notable ecological finding is the dual character of prey immigration: while it guarantees species persistence by preventing extinction, it concurrently extends the duration of transient oscillations before the system settles to steady state. All analytical results are corroborated by bifurcation diagrams, phase plane portraits, and maximum Lyapunov exponent computations.

Keywords: Leslie-Gower model, Bifurcation analysis, Nonstandard finite difference (NSFD) method, Chaos control, Constant prey influx.

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DYNAMICAL ANALYSIS OF A MEMORY-DEPENDENT 3D POPULATION MODEL

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ABSTRACT

This study investigates the dynamics of a discrete three-dimensional fractional-order model with constant-rate prey harvesting. The system consists of a prey population with logistic growth under harvesting, a predator feeding on the prey, and a scavenger benefiting from predator activity while subject to intraspecific competition. The continuous model is formulated by means of the Caputo fractional derivative to incorporate memory effects, and its discrete counterpart is derived using the piecewise constant arguments method. Existence and uniqueness of solutions for the continuous system are established by verifying local Lipschitz continuity, while non-negativity of the discrete model is proved by induction. The equilibrium structure is completely characterized, yielding prey-only, predator-prey, and coexistence equilibria, together with a biologically inadmissible case. In particular, the coexistence equilibrium leads to an explicit critical harvesting threshold beyond which the scavenger population becomes extinct. Local asymptotic stability of the coexistence equilibrium is analyzed through the Jury criterion, and the theoretical findings are supported by numerical simulations and time-series plots.

Keywords: Fractional-order system, Caputo derivative, Lotka-Volterra model, Constant harvesting, Jury stability.

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DOUBLE DİZİLER İÇİN RİESZ LACUNARY DÜZGÜN İNTEGRALLENEBİLİRLİK, RİESZ İSTATİSTİKSEL YAKINSAKLIK VE RİESZ KUVVETLİ YAKINSAKLIK

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ÖZET

Bu çalışmada, Quan ve arkadaşlarının tek indisli diziler için verdikleri çalışmayı büyük ölçüde double dizilere (çift indisli dizilere) genişletiyoruz. Tek indisli durumda tanımlanmış olan Riesz lacunary istatistiksel yakınsaklık ve kuvvetli Riesz lacunary yakınsaklık kavramları, bu çalışmada double diziler için yeniden ele alınarak kapsamlı bir şekilde tanıtılmıştır. Ayrıca, bu kavramlara ek olarak double diziler için Riesz lacunary düzgün integrallenebilirlik kavramı da ilk defa burada tanımlanmış ve literatüre kazandırılmıştır.

Çalışmanın temel amacı, bu yeni tanımlar arasındaki ilişkileri incelemek ve kuvvetli Riesz lacunary yakınsaklığın, lacunary istatistiksel yakınsaklığı gerektirip gerektirmediğini araştırmaktır. Bu bağlamda, öncelikle bir (x_{kl}) double reel dizisinin kuvvetli Riesz lacunary anlamında bir L limitine yakınsak olması durumunda, aynı dizinin aynı L limiti için lacunary istatistiksel yakınsak olduğu gösterilmiştir. Bu sonuç, tek indisli durumdaki benzer teoremlerin double dizilere doğal bir genellemesidir.

Ancak bu teoremin tersinin her zaman geçerli olmadığı belirlenmiştir. Ters yöndeki bir çıkarım için ek bir koşula ihtiyaç duyulduğu görülmüş ve bunun için ilk olarak $(a_k\overline{a}_l|x_{kl}-L|)$ dizisinin sınırlı olması gerektiği gösterilmiştir. Daha sonra, Ünver ve Orhan de kullanılan yöntem ile Quan ve arkadaşlarının yaklaşımından hareketle, bu sınırlılık şartının yerine daha zayıf ve daha genel bir koşul olan Riesz lacunary düzgün integrallenebilirlik şartı konularak teoremin tersinin yeniden ispatlanabileceği gösterilmiştir. Bu şekilde, elde edilen sonuç daha geniş bir dizi sınıfı için geçerli hale getirilmiştir.

Anahtar Kelimeler : Riesz yakınsaklık, lacunary istatistiksel yakınsaklık, Riesz lacunary istatistiksel yakınsaklık ve kuvvetli Riesz lacunary yakınsaklık, Riesz kuvvetli lacunary yakınsaklık, düzgün integrallenebilme, Riesz düzgün integrallenebilme. [2]

[1] Bu bildiri, ilk yazarın 2026 yılında Sivas Cumhuriyet Üniversitesi'nde tamamlayacağı yüksek lisans tezinden türetilmiştir.

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1. GİRİŞ

İstatistiksel yakınsaklık kavramı, ilk kez Zygmund, Steinhaus ve Fast tarafından [33], [28] ve [11] de birbirinden bağımsız olarak klasik yakınsaklık kavramının bir genellemesi olarak verilmiştir. Eğer, $\forall \varepsilon > 0$ için

$$\lim_n \frac{1}{n} |\{k \leq n: |x_k - L| \geq \varepsilon\}| = 0 \tag{1.1}$$

olacak şekilde bir L sayısı varsa, $x = (x_k)$ dizisi L sayısına *istatistiksel yakınsaktır* denir ve $st - \lim x = L$ veya $x_k \to L(st)$ ile gösterilir. Burada $|A|$ ile $A \subset \mathbb{N}$ nin kardinal sayısı gösterilir, yani $|A| = cardA$ dır. Tabiiki bir dizi yakınsak ise istatistiksel yakınsaktır. İstatistiksel yakınsaklık ile tanışıklığımız uzun yıllara dayansa da 1980 li ve 1990 lu yıllarda hız kazanmıştır. Fridy [5] istatistiksel Cauchy dizisini tanımladı, hiçbir toplanabilme metodunun istatistiksel yakınsaklık metodunu içermediğini gösterdi ve aynı zamanda bu çalışmasında bir Tauber tipi teorem verdi. Connor [2] $st - \lim x = L$ ise $x = (x_k)$ dizisisinin L ye yakınsayan ve 0 istatistiksel yakınsayan iki alt diziye ayrılabileceğini gösterdi. Eğer $0 < p < \infty$ için,

$$\lim_n \frac{1}{n} \sum_{k=1}^{n} |x_k - L|^p = 0 \tag{1.2}$$

olacak şekilde bir L sayısı varsa (x_k) dizisi L sayısına kuvvetli p-Cesàro toplanabilirdir denir ve $x \to L\ (w_p)$ şeklinde gösterilir. Eğer $p = 1$ ise (x_k) dizisi L ye kuvvetli toplanabilirdir denir ve $x \to L\ (w)$ şeklinde gösterilir. Connor aynı zamanda bir $x = (x_k)$ dizi L ye kuvvetli p-Cesàro toplanabilir ise L sayısına istatistiksel yakınsak olduğunu ve bu önermenin tersi için dizinin sınırlı olması gerektiğini gösterdi. Khan ve Orhan [9] bu bu önermenin tersinde gerekli olan sınırlılık şartından daha zayıf olan düzgün integrallenebilirlik koşuluyla yer değiştirdiler. Freedman ve arkadaşları [4] lacunary dizi tanımını ve kuvvetli lacunary yakınsaklık tanımlarını verdiler: Eğer $r \to \infty$ için

$$h_r := k_r - k_{r-1} \to \infty, (k_0 = 0)$$

ise pozitif tamsayıların artan bir $\theta = \{k_r\}$ dizisine bir lacunary dizi denir. Örneğin $\{k_r\} = \{2^r\}_{r=0}^{\infty}$ ve $\theta = \{k_r\} = \{r!\}_{r=0}^{\infty}$ iki lacunary dizi örneğidir. Herhangi bir $\theta = \{k_r\}$ lacunary dizisi için

$$\lim_r \frac{1}{h_r} \sum_{k \in I_r} |x_k - L| = 0 \tag{1.3}$$

olacak şekilde bir L sayısı varsa x, dizisi L sayısına N_θ anlamında yakınsak veya kuvvetli lacunary yakınsaktır denir ve $x_k \to L\ (N_\theta)$ şeklinde gösterilir. Fridy ve Orhan [6], aşağıdaki şekilde lacunary istatistiksel yakınsaklık tanımını verdiler: $\theta = \{k_r\}$ bir lacunary dizisi olmak üzere her $\varepsilon > 0$ için, $I_r := (k_{r-1}, k_r]$ olmak üzere

$$\lim_{r \to \infty} \frac{1}{h_r} |\{k \in I_r: |x_k - L| \geq \varepsilon\}| = 0 \tag{1.4}$$

ise $x = (x_k)$ dizisi L sayısına lacunary istatistiksel yakınsaktır denir ve $S_\theta - \lim x = L$ veya $x_k \to L$, (S_θ) sembolleriyle gösterilir. Fridy ve Orhan aynı çalışmada, bir $\theta = (k_r)$ lacunary

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dizisi için $x_k \to L(N_\theta)$ ise $x_k \to L(S_\theta)$ olduğun gösterdiler, önermenin tersi için Connor un çalışmasındaki gibi (x_k) dizisi üzerine sınırlılık şartı getirilmesi gerektiğini gösterdiler.

$p_0 > 0$ olmak üzere negatif olmayan reel sayıların (p_k) dizisi için $P_n = \sum_{k=0}^{n} p_k$ serinin n.kısmi toplamı olsun.

$$R_n = \frac{1}{P_n}\sum_{k=0}^{n} p_k x_k \tag{1.5}$$

ya $x = (x_k)$ dizisinin Riesz ortalaması (veya ağırlıklı ortalama) denir. Eğer $\lim_{n\to\infty} R_n = L$ ise $x = (x_k)$ dizisi L ye Riesz toplanabilirdir denir. $x_k \to L$ için $R_n \to L$ ise Riesz ortalamasına regülerdir denir. Toplanabilme teorisinde bir matris dönüşümünün regüler olması Silvermann-Teoplitz Teoremi ile verilmiştir. Riesz ortalamasının regüler olması için gerek ve yeter şart

$$n \to \infty \text{ için } P_n \to \infty$$

olduğu iyi bilinir [14, p.10].

Quan ve arkadaşları [13] Riesz istatistiksel yakınsaklık tanımını verdiler: $A \subset \mathbb{N}$ ve $A_n := \{k \le P_n : k \in A\}$ olmak üzere

$$\delta_R(A) = \lim_{n\to\infty} \frac{1}{P_n} |A_n|$$

mevcutsa buna A nın Riesz yoğunluğu denir. Eğer $\varepsilon > 0$ için

$$\lim_{n\to\infty} \frac{1}{P_n} |\{k : k \le P_n \text{ ve } p_k |x_k - L| \ge \varepsilon\}| = 0, \tag{1.6}$$

yani; $A(\varepsilon, R) = \{k : k \le P_n \text{ ve } p_k |x_k - L| \ge \varepsilon\}$ olmak üzere $\delta_R\big(A(\varepsilon, R)\big) = 0$ ise (x_n) dizisi L ye Riesz istatistiksel yakınsaktır denir ve $Rst - \lim x = L$ şeklinde gösterilir.

Eğer bu tanımda her n için $p_n = 1$ alınır ise bu yakınsaklık istatistiksel yakınsaklığa indirgenir.

Quan ve arkadaşları [13] Riesz lacunary istatistiksel yakınsaklık ve Riesz lacunary kuvvetli istatistiksel yakınsaklık tanımını verdiler:

$\theta = (k_r)$ bir lacunary dizi olsun. Bu durumda, reel sayıların pozitif (p_k) dizisi aşağıdakileri sağlasın:

$$P_0 := 0 \quad , P_{k_r} := \sum_{l\in(0,k_r]} p_l,\ P_{k_{r-1}} := \sum_{l\in(0,k_{r-1}]} p_l, Q_r := \frac{P_{k_r}}{P_{k_{r-1}}},$$
$$H_r := \sum_{l\in I_r} p_l = P_{k_r} - P_{k_{r-1}} \text{ve } \liminf p_l > 0.$$

Bir $\theta = (k_r)$ lacunary dizisi ve (p_n) dizisi yardımıyla $J_r = \left(P_{k_{r-1}}, P_{k_r}\right]$ yarı açıklarını belirleyelim. Dolayısıyla $\theta' = \left(P_{k_r}\right)$ ile bir Riesz lacunary dizi tanımlanır. Burada $P_0 = 0$ ve $r \to \infty \, için \, H_r = P_{k_r} - P_{k_{r-1}} \to \infty$ elde edilir. Eğer her $n \in \mathbb{N}$ için $p_n = 1$ alırsak, P_{k_r}, $P_{k_{r-1}}$, Q_r, H_r, J_r sırasıyla k_r, k_{r-1}, q_r, h_r, I_r olur.

Eğer her $\varepsilon > 0$ için

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$$\lim_{r\to\infty}\frac{1}{H_r}|\{l: l\in J_r \text{ ve } p_l|x_l-L|\geq\varepsilon\}|=0 \tag{1.7}$$

ise $x=(x_n)$ dizisi L ye Riesz lacunary istatistiksel yakınsaktır denir ve $x_n\to L(RLS)$ veya $RLS-\lim x=L$ şeklinde gösterilir.

Eğer

$$\lim_{r\to\infty}\frac{1}{H_r}\sum_{l\in I_r}p_l|x_l-L|=0, \tag{1.8}$$

ise (x_n) dizisi L ye Riesz lacunary kuvvetli istatistiksel yakınsaktır denir ve $x_n\to L(w(RL))$ veya $w(RL)-\lim x=L$ yazılır.

Quan ve arkadaşları aynı makalelerinde, Connor, Fridy ve Orhan ın çalışmalarına benzer olarak $x_n\to L(w(RL))$ ise $x_n\to L(RLS)$ olduğunu fakat önermenin tersi için $(p_n|x_n-L|)$ dizisinin sınırlılık şartı gerektiğini göstermişlerdir.

$f:\mathbb{N}\times\mathbb{N}\to\mathbb{K}$, ($\mathbb{K}=\mathbb{R}$ veya $\mathbb{C}$) olan fonksiyona reel veya kompleks terimli double dizi denir. Eğer $\|x\|_{(\infty,2)}=\sup_{j,k}|x_{jk}|<\infty$ ise $x=(x_{jk})$ dizisine sınırlıdır denir ve tüm sınırlı reel veya kompleks double dizilerin kümesi ℓ_∞^2 ile gösterilir. $(\ell_\infty^2,\|x\|_{(\infty,2)})$ bir normlu uzaydır. $x=(x_{jk})$, gerçel ya da karmaşık terimli bir çift dizi olsun. Eğer

$$\forall\varepsilon>0:\forall j,k\geq N:|x_{jk}-L|<\varepsilon$$

olacak şekilde bir $N=N(\varepsilon)\in\mathbb{N}$ varsa, bu durumda $x=(x_{jk})$ dizisi Pringsheim anlamında L sayısına yakınsaktır (veya P-yakınsaktır) denir ve P-$\lim x=L$ şeklinde gösterilir [10]. Tabiiki tek indisli dizilerde olduğu gibi double diziler için P-yakınsak dizi sınırlıdır diyemiyoruz.

Mursaleen ve Edely [12], Móricz [11] birbirinden bağımsız olarak double diziler için istatistiksel yakınsaklık kavramlarının tanımlarını vermişlerdir: $x=(x_{jk})$ bir reel double dizi olsun. Eğer her $\varepsilon>0$ için

$$P-\lim_{m,n}\frac{1}{mn}|\{(j,k),j\leq m,k\leq n:|x_{jk}-L|\geq\varepsilon\}|=0$$

ise bu durumda x dizisi L sayısına istatistiksel yakınsaktır denir ve st_2-$\lim_{j,k}x_{jk}=L$ şeklinde yazılır.

Dört boyutlu matrisler için A-toplanabilirlik de tanımlandı ve bir dört boyutlu bir $A=(a_{mnjk})$ matrisinin RH-regüler (Robison-Hamilton regülerliği) olması için gerek ve yeter şart Robison-Hamilton koşullarının sağlanmasıdır([15], [7]).

Definition 1.1 *$A=(a_{mnjk})$, $m,n,j,k\in\mathbb{N}$, dört boyutlu bir matris ve $x=(x_{jk})$ çift indisli bir dizi olsun. Eğer her $(m,n)\in\mathbb{N}^2:=\mathbb{N}\times\mathbb{N}$ için*

$$y_{mn}:=(Ax)_{mn}=\sum_{j,k=1,1}^{\infty,\infty}a_{mnjk}x_{jk}=\sum_{j=1}^{\infty}\sum_{k=1}^{\infty}a_{jk}^{mn}x_{jk}$$

serisi Pringsheim anlamında yakınsak ise, $Ax=(y_{mn})$ dizisine x dizisinin A-dönüşümü denir.

Eğer x dizisinin A-dönüşüm dizisi her $m,n\in\mathbb{N}$ için mevcut ve bir L değerine Pringsheim anlamında yakınsak ise, yani

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$$P-\lim_{p,q}\sum_{j,k=1,1}^{p,q} a_{mnjk}x_{jk}=y_{mn}$$

ve

$$P-\lim_{m,n} y_{mn}=L$$

ise bu durumda $x=(x_{jk})$ dizisi L değerine A-toplanabilirdir denir.

1926 yılında Robison dört boyutlu matrislerin regülerlik kavramını, P-yakınsak bir dizinin sınırlı olması gerekmediğinden sınırlılık koşulunu da ekleyerek tanımlamıştır. Dört boyutlu matrisler için bu tanım Robison-Hamilton regülerliği veya RH-regülerlik olarak bilinir [15], [7]. Buna göre, $A=(a_{mnjk})$ dört boyutlu bir matris ve $x=(x_{jk})$ "sınırlı" bir çift indisli dizi olmak üzere eğer P-lim$x=L$ iken P-lim$y_{mn}=L$ oluyorsa bu durumda A matrisine RH-regüler matris denir.

Theorem 1.1 *Dört boyutlu $A=(a_{mnjk})$ matrisinin RH-regüler (veya sınırlı-regüler) olması için gerek ve yeter şart aşağıdaki Robison-Hamilton koşullarının sağlanmasıdır:*

(RH_1) Her $(j,k)\in\mathbb{N}^2$ için $P-\lim_{m,n} a_{mnjk}=0$,

(RH_2) $P-\lim_{m,n}\sum_{(j,k)\in\mathbb{N}^2} a_{mnjk}=1$,

(RH_3) Her $j\in\mathbb{N}$ için $P-\lim_{m,n}\sum_{k\in\mathbb{N}}\left|a_{mnjk}\right|=0$,

(RH_4) Her $k\in\mathbb{N}$ için $P-\lim_{m,n}\sum_{j\in\mathbb{N}}\left|a_{mnjk}\right|=0$,

(RH_5) Her $(m,n)\in\mathbb{N}^2$ için $\sum_{(j,k)\in\mathbb{N}^2}\left|a_{mnjk}\right|\leq C<\infty$.

Örneğin, dört boyutlu Cesàro matrisi olarak adlandırılan ve $C(1,1)=\left(c_{mnjk}\right)$,

$$c_{mnjk}=\begin{cases}\frac{1}{mn} & ;1\leq j\leq m,1\leq k\leq n\\ 0 & ;\text{diğer yerlerde}\end{cases}$$

şeklinde tanımlanan $C(1,1)$ matrisi RH-regülerdir.

Mursaleen ve Edely [12] $x=\left(x_{jk}\right)$ bir double reel sayı dizisi için,

$$\lim_{n,m}\frac{1}{nm}\sum_{j=1}^{n}\sum_{k=1}^{m}x_{jk}=L$$

oluyorsa bu durumda x dizisi L sayısına Cesàro toplanabilirlik tanımını ve $p\in\mathbb{R}^+$ olmak üzere eğer

$$\lim_{n,m}\frac{1}{nm}\sum_{j=1}^{n}\sum_{k=1}^{m}\left|x_{jk}-L\right|^p=0$$

ise, x dizisi L ye kuvvetli p-Cesàro toplanabilirlik tanımlarını verdiler, tüm Cesàro toplanabilir dizilerin kümesini, $(C,1,1)$ ve tüm kuvvetli p-Cesàro toplanabilir double dizilerin uzayı w_p^2 ile gösterdiler. Onlar aynı zamanda, Connor, Fridy ve Orhan ın çalışmalarına benzer olarak eğer $\left(x_{jk}\right)$ double reel sayı dizisi L ye kuvvetli p-Cesàro toplanabilir ise L ye istatistiksel yakınsak olduğunu gösterdiler ve önermenin tersi için sınırlılık şartı gerektiğini gösterdiler.

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2. ANA SONUÇLAR

Yukarıda Tanımları verilen $Rst-\lim x=L$ ve $RLS-\lim x=L$ yakınsaklıkları için aşağıdaki teoremleri verebiliriz.

Theorem 2.1 *$Rst-limx=L_1$ ve $Rst-limy=L_2$ mecut ve $\alpha\in\mathbb{R}$ olsun. Bu durumda*

$(i)\ Rst-\lim(x+y)=Rst-\lim x+Rst-\lim y$

$(ii)\ Rst-\lim(\alpha x)=\alpha.Rst-\lim x.$

dir.

Proof. (i) ♣ $Rst-\lim x=L_1\Rightarrow\forall\varepsilon>0$ için $\forall k>k_1$ ve $\forall k\notin A$ icin $p_k|x_k-L_1|<\varepsilon/2$ olacak şekilde $k_1\in\mathbb{N}$ ve $\delta_R(A)=0$ olacak şekilde $A\subset\mathbb{N}$ vardır.

♣ $Rst-\lim y=L_2\Rightarrow\forall\varepsilon>0$ için $\forall k>k_2$ ve $\forall k\notin B$ icin $p_k|y_k-L_2|<\varepsilon/2$ olacak şekilde $k_2\in\mathbb{N}$ ve $\delta_R(B)=0$ olacak şekilde $B\subset\mathbb{N}$ vardır.

♠ $k_0:=\max\{k_1,k_2\}$ diyelim.

$\Rightarrow\delta_R(A)=0$ ve $\delta_R(B)=0\Rightarrow\delta_R(A\cap B)=0$ olduğundan, $\forall k\notin(A\cap B)$ ve $\forall k>k_0$ için

$$\begin{aligned}p_k|(x_k+y_k)-(L_1+L_2)| &\leq p_k|x_k-L_1|+p_k|y_k-L_2|\\ &<\varepsilon/2+\varepsilon/2=\varepsilon\end{aligned}$$

dir.

$$\Rightarrow\lim_n\frac{1}{P_n}|\{k\leq P_n:p_k|(x_k+y_k)-(L_1+L_2)|\geq\varepsilon\}|=0$$

$$Rst-\lim(x+y)=Rst-\lim x+Rst-\lim y\text{dir.}$$

(ii) Eğer $\alpha=0\Rightarrow$ durum açık. $\Rightarrow\alpha\neq0$ ve $Rst-\lim x=L$ olsun.

♣ $Rst-\lim x=L\Rightarrow\forall\varepsilon>0$ için $\forall k>k_0$ ve $\forall k\notin A$ icin $p_k|x_k-L|<\varepsilon/|\alpha|$ olacak şekilde $k_0\in\mathbb{N}$ ve $\delta_R(A)=0$ olacak şekilde $A\subset\mathbb{N}$ vardır.

$\Rightarrow\forall k\notin A$ ve $\forall k>k_0$ için

$$p_k|\alpha x_k-\alpha L|=|\alpha|.p_k|x_k-L|<|\alpha|.\varepsilon/|\alpha|=\varepsilon$$

$$\Rightarrow\lim_n\frac{1}{P_n}|\{k\leq P_n:p_k|\alpha x_k-\alpha L|\geq\varepsilon\}|=0$$

$$Rst-\lim(\alpha x)=\alpha.Rst-\lim x\text{dir.}$$

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Teorem 2.1 deki yöntem ile aşağıdaki Teoremi ispatsız olarak verebiliriz.

Theorem 2.2 *$RLS-limx=L_1$ ve $RLS-limy=L_2$ mecut ve $\alpha\in\mathbb{R}$ olsun. Bu durumda*

$(i)\ RLS-\lim(x+y)=RLS-\lim x+RLS-\lim y$

$(ii)\ RLS-\lim(\alpha x)=\alpha.RLS-\lim x.$

dir.

Aşağıdaki tanım ve bu tanıma ilişkin örnek ve teorem Quan ve arkadaşlarının [13] çalışmasında görülebilir.

Definition 2.1 *Eğer*

$$\lim_{m\to\infty}\sup_{r}\frac{1}{H_r}\sum_{l\in J_r:|x_l|\geq m}|x_l|=0$$

ise bir $x=(x_n)$ dizisne Riesz lacunary düzgün integrallenebilirdir denir (kısaca RLU ile gösterilir)

Theorem 2.3 *Aşağıdakiler denktir*

$(i)\ x_k\to L\ \big(w(RL)\big).$

$(ii)\ x_k\to L(RLS)$ ve $x=(x_k)$, RLU dur.

Benzer şekilde double diziler için de tek indisli dizilerde olduğu gibi parelel şekilde aşağıdaki tanımları ve sonuçları verilebilir.

Ekrem Savaş [16] double lacunary diziyi aşağıdaki şekilde tanımlamıştır: (k_r) ve (l_s) negatif olmayan tamsayıların artan bir dizisi olsun. Eğer

$$k_0=0,\quad r\to\infty \text{ iken } h_r:=k_r-k_{r-1}\to\infty$$
$$l_0=0,\quad s\to\infty \text{ iken } \overline{h}_s=(l_s-l_{s-1})\to\infty$$

ise $\theta_{rs}=\{(k_r,l_s)\}$ dizisine bir double lacunary dizi denir. $k_{rs}:=k_rl_s$, $h_{rs}:=h_r\overline{h}_s$ alalım. θ_{rs} dizisi için

$$I_{rs}:=\{(k,l):k_{r-1}<k\leq k_r \text{ ve } l_{s-1}<l\leq l_s\}=(k_{r-1},k_r]\times(l_{s-1},l_s]$$

aralıklarını belirleyelim. Litaratürde $q_r:=\frac{k_r}{k_{r-1}}$, $\bar{q}_s:=\frac{l_s}{l_{s-1}}$, $q_1=k_1$ ve $\bar{q}_1=l_1$ ve $q_{rs}:=q_r\bar{q}_s$ şeklinde gösterilir [16].

Çakan ve Arkadaşları [3] aşağıdaki tanımı verdiler: $\theta_{rs}=\{(k_r,l_s)\}$ bir double lacunary dizi olsun. Eğer her $\varepsilon>0$ için

$$\lim_{r,s\to\infty}\frac{1}{h_{rs}}|\{(k,l)\in I_{rs}:|x_{kl}-L|\geq\varepsilon\}|=0$$

ise double $x=(x_{kl})$ dizisi, L ye lacunary istatistiksel yakınsaktır denir ve $S_{\theta_{rs}}-\lim x=L$ veya $x_{kl}\to L$, $(S_{\theta_{rs}})$ sembolleriyle gösterilir.

Alotaibi and C. Çakan [1] aşağıdaki tanımı verdiler: (a_n) ve $(\bar{a}_m)$ negatif olmayan reel sayı dizileri ve $a_0>0$, $\bar{a}_0>0$ ve

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$$A_n := \sum_{k=0}^{n} a_k \to \infty, (n \to \infty)$$
$$\bar{A}_m := \sum_{l=0}^{m} \bar{a}_l \to \infty, (m \to \infty)$$

olsun. Bu durumda

$$R_{nm}(x) = \frac{1}{A_n \bar{A}_m} \sum_{k=0}^{n} \sum_{l=0}^{m} a_k \bar{a}_l x_{kl}$$

ye double (x_{kl}) dizisinin Riesz ortalaması denir. Eğer $P - \lim R_{nm} = L$ ise (x_{kl}) dizisi L ye Riesz yakınsaktır denir ve $x_{kl} \to L(DR)$ şeklinde gösterilir.

Yine Ekrem Savaş [16] aşağıdaki tanımı vermiştir. Eğer her $\varepsilon > 0$ için

$$\lim_{n,m\to\infty} \frac{1}{A_n \bar{A}_m} |\{k \le A_n \text{ ve } l \le \bar{A}_m : a_k \bar{a}_l |x_{kl} - L| \ge \varepsilon\}| = 0$$

ise bu durumda (x_{kl}) dizisi L ye Riesz statistiksel yakınsaktır denir ve $RS^2 - \lim x = L$ yazılır.

Eğer $\forall\ k, l \in \mathbb{N}$ için $a_k = \bar{a}_l = 1$ ise, bu durumda (x_{kl}) dizisinin Riesz istatistiksel yakınsaklığı, (x_{kl}) dizisinin istatistiksel yakınsaklığına indirgenir.

(a_k) ve $(\bar{a}_l)$ pozitif reel sayı dizileri

$$\begin{aligned}
A_{k_r} &:= \sum_{k\in(0,k_r]} a_k \text{ ve } Q_r = \frac{A_{k_r}}{A_{k_{r-1}}}, \\
\bar{A}_{l_s} &:= \sum_{l\in(0,l_s]} \bar{a}_l \text{ ve } \bar{Q}_s = \frac{\bar{A}_{l_s}}{\bar{A}_{l_{s-1}}}, \\
H_r &:= \sum_{k\in I_r} a_k = A_{k_r} - A_{k_{r-1}}, A_0 = 0 \text{ ve } \liminf a_k > 0, \\
\bar{H}_s &:= \sum_{l\in I_s} \bar{a}_l = \bar{A}_{l_s} - \bar{A}_{l_{s-1}}, \bar{A}_0 = 0 \text{ ve } \liminf \bar{a}_l > 0.
\end{aligned}$$

özelliklerini gerçeklemek üzere $\theta_{rs} = \{(k_r, l_s)\}$ bir double lacunary dizi olsun. Eğer Double dizilerin Riesz ortalaması RH-regüler ise bu durumda $\theta'_{rs} = (A_{k_r}, \bar{A}_{l_s})$ bir double lacunary dizidir; yani,

$$\begin{aligned}
&A_0 = 0, 0 < A_{k_{r-1}} < A_{k_r} \text{ ve } H_r = A_{k_r} - A_{k_{r-1}} \to \infty,\ (r \to \infty) \\
&\bar{A}_0 = 0, 0 < \bar{A}_{l_{s-1}} < \bar{A}_{l_s} \text{ ve } \bar{H}_s = \bar{A}_{l_s} - \bar{A}_{l_{s-1}} \to \infty,\ (s \to \infty).
\end{aligned}$$

dir. $A_{k_r l_s} := A_{k_r} \bar{A}_{l_s}$, $H_{rs} = H_r \bar{H}_s$, $Q_{rs} = Q_r \overline{Q}_s$,

$$J_{rs} := \left\{(j,k) : A_{k_{r-1}} < j \le A_{k_r} \text{ ve } \overline{A}_{l_{s-1}} < k \le \bar{A}_{l_s}\right\}.$$

diyelim. Eğer her $a_k = \bar{a}_l = 1$ alırsak, bu durumda

$$\begin{aligned}
&A_{k_r} = k_r, \quad Q_r = \frac{k_r}{k_{r-1}} = q_r, \quad H_r = A_{k_r} - A_{k_{r-1}} = k_r - k_{r-1} = h_r \\
&\overline{A}_{l_s} = l_s, \quad \overline{Q}_s = \frac{l_s}{l_{s-1}} = \overline{q}_s, \quad \overline{H}_s = \overline{A}_{l_s} - \overline{A}_{l_{s-1}} = l_s - l_{s-1} = \overline{h}_s
\end{aligned}$$

$$A_{k_r l_s} = A_{k_r} \bar{A}_{l_s} = k_r l_s = k_{rs}, H_{rs} = H_r \bar{H}_s = h_r \overline{h}_s = h_{rs}, Q_{rs} = Q_r \overline{Q}_s = q_r \overline{q}_s = q_{rs}$$

ve

$$\begin{aligned}
J_{rs} &:= \left\{(j,k) : A_{k_{r-1}} < j \le A_{k_r} \text{ ve } \bar{A}_{l_{s-1}} < k \le \bar{A}_{l_s}\right\} \\
&= \{(j,k) : k_{r-1} < j \le k_r \text{ ve } l_{s-1} < k \le l_s\} = I_{rs}
\end{aligned}$$

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olacağı açıktır.

Definition 2.2 *Eğer her* $\varepsilon > 0$ *için*

$$\lim_{r,s\to\infty} \frac{1}{H_{rs}} |\{(k,l) \in J_{rs}: a_k \bar{a}_l |x_{kl} - L| \geq \varepsilon\}| = 0$$

ise bu durumda $x = (x_{kl})$ dizisi L ye Riesz lacunary istatistiksek yakınsaktır denir ve $x_{kl} \to L$, (R^2LS) ile gösterilir.

Teorem 2.1 deki yöntem ile aşağıdaki Teoremi ispatsız olarak verebiliriz.

Theorem 2.4 $R^2LS - limx = L_1$ *ve* $R^2LS - limy = L_2$ *mecut ve* $\alpha \in \mathbb{R}$ *olsun. Bu durumda*

(i) $R^2LS - \lim(x+y) = R^2LS - \lim x + R^2LS - \lim y$

(ii) $R^2LS - \lim(\alpha x) = \alpha . R^2LS - \lim x.$

dir.

Example 2.1 (a_k), $(\bar{a}_l)$ *tüm* $k, l \in \mathbb{N}$ *için* $a_k = \bar{a}_l = 1$ *ile tanımlanan sabit bir dizi olsun. Her* $r, s \in \mathbb{N}$ *için* $k_r = 2^r$, $l_s = 2^s$ *tarafından tanımlanan double lacunary diziyi* $\theta_{rs} = \{(k_r, l_s)\}$ *düşünün. Daha sonra* $r \to \infty$ *olarak* $H_r = k_r - k_{r-1} = 2^r - 2^{r-1} = 2^{r-1} \to \infty$ *ve* $s \to \infty$ *olarak* $\bar{H}_s = l_s - l_{s-1} = 2^s - 2^{s-1} = 2^{s-1} \to \infty$ *dır. Bir* $x = (x_{kl})$ *dizisini şu şekilde tanımlayalım:*

$$x_{kl} = \begin{cases} 1 + \frac{1}{kl} & , \text{eğer } k = n^2, l = m^2 n, m \in \mathbb{N}, \\ 1 & , \text{diğer.} \end{cases}$$

Şimdi,

$$\lim_{r,s\to\infty} \frac{1}{H_{rs}} |\{(k,l): (k,l) \in J_{rs} \text{ ve } a_k \bar{a}_l |x_{kl} - 1| \geq \varepsilon\}|$$

$$= \lim_{r,s\to\infty} \frac{1}{h_{rs}} |\{(k,l) \in I_{rs} \text{ ve } |x_{kl} - 1| \geq \varepsilon\}|$$
$$= \lim_{r,s\to\infty} \frac{1}{2^{r-1}} \frac{1}{2^{s-1}} |\{(k,l) \in I_{rs} \text{ ve } |x_{kl} - 1| \geq \varepsilon\}|$$
$$\leq \lim_{r,s\to\infty} \frac{1}{2^{r-1}} \frac{1}{2^{s-1}} \to 0, (r, s \to \infty).$$

Dolayısıyla, $x = (x_{kl})$ Riesz double lacunary istatistiğinin 1 e yakınsamasıdır.

Definition 2.3 *[16]Eğer*

$$\lim_{r,s\to\infty} \frac{1}{H_{rs}} \sum_{(k,l)\in J_{rs}} a_k \bar{a}_l |x_{kl} - L| = 0$$

ise double (x_{kl}) dizisi L ye Riesz lacunary kuvvetli toplanabilirdir denir ve $x_{kl} \to L\big(w(R^2L)\big)$ şeklinde gösterilir.Bu durumda $x_{kl} \to L\big(w(R^2L)\big)$ yazarız.

Example 2.2 (a_k),$(\bar{a}_l)$ *tüm* $k, l \in \mathbb{N}$ *için* $a_k = \bar{a}_l = 1$ *ile tanımlanan sabit dizi olsun. Her* $r, s \in \mathbb{N}$ *için* $k_r = 2^r$,$l_s = 2^s$ *ile tanımlanan* $\theta_{rs} = \{(k_r, l_s)\}$ *double lacunary dizisini alalım. Daha sonra*

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$$h_r = k_r - k_{r-1} = 2^r - 2^{r-1} = 2^{r-1} \to \infty, (r \to \infty),$$
$$\bar{h}_s = l_s - l_{s-1} = 2^s - 2^{s-1} = 2^{s-1} \to \infty, (s \to \infty).$$

Bir $x = (x_{kl})$ dizisini aşağıdaki şekilde tanımlayalım:

$$x_{kl} = \begin{cases} \frac{1}{kl} & , k, l \text{ tek}, \\ 0 & , \text{diğer}. \end{cases}$$

$a_k = \bar{a}_l = 1$ olduğundan, her $r, s \in \mathbb{N}$ için $J_{rs} = I_{rs}$ dir. Şimdi,

$$\begin{aligned} \frac{1}{H_{rs}} \sum_{(k,l)\in I_{rs}} a_k \bar{a}_l |x_{kl} - L| &= \frac{1}{2^{r-1}} \frac{1}{2^{s-1}} \sum_{(k,l)\in I_{rs}} |x_{kl}| \\ &= \frac{1}{2^{r-1}} \frac{1}{2^{s-1}} \sum_{\substack{(k,l)\in I_{rs} \\ k,l \text{ tek}}} \frac{1}{k} \frac{1}{l}, \left(\frac{1}{k} < \frac{1}{2^{r-1}} \text{ ve } \frac{1}{l} < \frac{1}{2^{s-1}}\right) \\ &\leq \frac{1}{2^{r-1}} \frac{1}{2^{s-1}} \sum_{(k,l)\in I_{rs}} \frac{1}{2^{r-1}} \frac{1}{2^{s-1}} = \left(\frac{1}{2^{r-1}} \cdot \frac{1}{2^{r-1}} \cdot \frac{2^{r-1}}{2}\right) \cdot \frac{1}{2^{s-1}} \cdot \frac{1}{2^{s-1}} \cdot \frac{2^{s-1}}{2} \\ &= \frac{1}{2^r} \frac{1}{2^s} \to 0, (r, s \to \infty). \end{aligned}$$

Bu nedenle, $x = (x_{kl})$ dizisi 0 a Riesz double lacunary kuvvetli toplanabilirdir.

Yukarıdan beri kullanılan yöntemi double diziler için Riesz lacunary istatistiksel yakınsaklık ve Riesz lacunary kuvvetli toplanabilirliğe uyguladık.

Theorem 2.5 *Eğer $x_{kl} \to L$ $\left(w(R^2L)\right)$ ise bu durumda $x_{kl} \to L$ (R^2LS) dir.*

Proof. Eğer $\forall\, k, l \in \mathbb{N}^2$, $a_k \bar{a}_l |x_{kl} - L| \leq N$ için $x_{kl} \to L(R^2LS)$ ise,

$$\begin{aligned} \frac{1}{H_{rs}} \sum_{(k,l)\in I_{rs}} a_k \bar{a}_l |x_{kl} - L| &= \frac{1}{H_{rs}} \sum_{\substack{(k,l)\in I_{rs} \\ (k,l)\in R_{rs}(\varepsilon)}} a_k \bar{a}_l |x_{kl} - L| \\ &+ \frac{1}{H_{rs}} \sum_{\substack{(k,l)\in I_{rs} \\ (k,l)\notin R_{rs}(\varepsilon)}} a_k \bar{a}_l |x_{kl} - L| \\ &\leq \frac{N}{H_{rs}} \sum_{\substack{(k,l)\in J_{rs} \\ (k,l)\in R_{rs}(\varepsilon)}} 1 + \frac{\varepsilon}{H_{rs}} \sum_{\substack{(k,l)\in J_{rs} \\ (k,l)\notin R_{rs}(\varepsilon)}} 1 \\ &\leq \frac{N}{H_{rs}} |R_{rs}(\varepsilon)| + \varepsilon \frac{h_{rs}}{H_{rs}} \to \varepsilon, (r, s \to \infty). \end{aligned}$$

$x_{kl} \to L\left(w(R^2L)\right)$ dır.

Theorem 2.6 *Eğer $x_{kl} \to L(R^2LS)$ ve her k, l için $a_k \bar{a}_l |x_{kl} - L| \leq N$ ise $x_{kl} \to L\left(w(R^2L)\right)$ dir.*

Proof. Eğer $\forall\, k, l \in \mathbb{N}^2$, $a_k \bar{a}_l |x_{kl} - L| \leq N$ için $x_{kl} \to L(R^2LS)$ ise,

$$\begin{aligned} \frac{1}{H_{rs}} \sum_{(k,l)\in I_{rs}} a_k \bar{a}_l |x_{kl} - L| &= \frac{1}{H_{rs}} \sum_{\substack{(k,l)\in I_{rs} \\ (k,l)\in R_{rs}(\varepsilon)}} a_k \bar{a}_l |x_{kl} - L| \\ &+ \frac{1}{H_{rs}} \sum_{\substack{(k,l)\in I_{rs} \\ (k,l)\notin R_{rs}(\varepsilon)}} a_k \bar{a}_l |x_{kl} - L| \\ &\leq \frac{N}{H_{rs}} \sum_{\substack{(k,l)\in J_{rs} \\ (k,l)\in R_{rs}(\varepsilon)}} 1 + \frac{\varepsilon}{H_{rs}} \sum_{\substack{(k,l)\in J_{rs} \\ (k,l)\notin R_{rs}(\varepsilon)}} 1 \\ &\leq \frac{N}{H_{rs}} |R_{rs}(\varepsilon)| + \varepsilon \frac{h_{rs}}{H_{rs}} \to \varepsilon (r, s \to \infty). \end{aligned}$$

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$x_{kl} \to L\big(w(R^2L)\big)$ dır.

Definition 2.4 *Eğer* $x = (x_{kl})$ *dizisi*

$$\lim_{\alpha\to\infty} \sup_{r,s} \frac{1}{H_{rs}} \sum_{\substack{(k,l)\in J_{rs} \\ |x_{kl}|\geq\alpha}} |x_{kl}| = 0$$

Riesz double lacunary düzgün integrallenebilirdir (veya R^2LU)

Teorem 2.6 de, her $w(R^2L)$ nin R^2LS olduğunu, bunun tersinin sınırlı diziler için geçerli olduğunu tespit ettik. Sınırlılık koşulunu, düzgün integrallenebilirlik gibi biraz daha zayıf bir varsayımla değiştirerek aşağıdaki teoremi tekrar verilebilir.

Theorem 2.7 *Aşağıdakiler denktir:*

(i) $x_{kl} \to L\ \big(w(R^2L)\big)$.

(ii) $x_{kl} \to L(R^2LS)$ ve $x = (x_{kl})$ R^2LU.

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MEAN SQUARED ERROR MATRIX COMPARISONS BETWEEN WEIGHTED MIXED REGRESSION ESTIMATION

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ABSTRACT

To overcome the multicollinearity problem, a new class of estimator, namely two parameter weighted mixed estimator (TPWME) is introduced by Özbay and Kaçıranlar. This estimator is a general estimator which includes weighted mixed estimator (WME) of Schaffrin and Toutenburg, weighted mixed Liu estimator (WMLE) of Yang et al. and weighted mixed ridge estimator (WMRE) of Li and Yang. The purpose of this study is to discuss the comparison of some of the above-mentioned other weighted estimators created as alternatives to the WME according to the mean square error matrix (MSE). Theoretical findings are supported by a numerical example.

Keywords: Weighted mixed estimator; Liu estimator; Ridge estimator; Two parameter estimator; Mean square error

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SOME INTEGRAL TYPE BEST PROXIMITY CIRCLE RESULTS ON G-METRIC SPACES

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ABSTRACT

This study proposes a novel approach to the fixed-circle problem in G-metric spaces by introducing the concept of a best proximity circle and employing integral-type inequalities. G-metric spaces, as a generalization of classical metric spaces, provide a more flexible framework for analyzing nonlinear problems and mappings. However, existing results on fixed-circle problems in such spaces remain limited, particularly when dealing with non-self mappings and situations where exact fixed circles do not exist. To address this gap, we define the notion of a best proximity circle as an extension of best proximity point theory, aiming to identify optimal approximate solutions when fixed-circle conditions cannot be satisfied. By utilizing integral-type contractive conditions, we establish a new best proximity circle theorem in the setting of G-metric spaces. This approach allows for a broader class of mappings and weaker conditions compared to traditional contraction principles. The main results not only generalize several existing theorems in the literature but also provide a unified framework for studying proximity-based solutions in circular structures. Moreover, illustrative examples are presented to demonstrate the applicability and effectiveness of the proposed theorem. The findings of this study contribute to the development of fixed-circle theory and open new directions for future research in nonlinear analysis, particularly in areas involving generalized distance structures and approximation methods.

Keywords : G-metric spaces, fixed-circle problem, best proximity circle.

1. INTRODUCTION AND PRELIMANIRES

Fixed point theory has been a central topic in nonlinear analysis due to its wide range of applications in mathematics, engineering, and applied sciences. In recent years, attention has shifted toward the study of generalized metric structures, particularly G-metric spaces, which provide a more flexible framework for analyzing nonlinear problems. These spaces, introduced as an extension of classical metric spaces, allow the treatment of various problems that may not be approachable within standard settings.

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On the other hand, best proximity point theory has emerged as a natural generalization of fixed point theory for non-self mappings, where the existence of an exact fixed point is not guaranteed. Instead, one seeks points that minimize the distance between sets. This concept has been further enriched by geometric perspectives, leading to notions such as best proximity circles, which extend the idea of optimal proximity from points to geometric structures.

Motivated by these developments, this paper aims to establish a new best proximity circle result in the setting of G-metric spaces by employing a geometric approach combined with integral-type contractive conditions. The use of integral inequalities provides a powerful tool to generalize classical contraction principles, while the geometric viewpoint offers deeper insight into the structure of the solution set. The obtained results not only extend existing works in the literature but also contribute to the growing interaction between geometric methods and generalized metric theories.

To ensure clarity and completeness, we first review the main concepts and definitions that form the foundation of our study.

Definition 1.1. [1] A nonempty set X together with a function $G: X \times X \times X \to [0,\infty)$ is called a G-metric space, denoted by (X,G) if G satisfies

(G1) $G(x,y,z) = 0 \Leftrightarrow x = y = z,$

(G2) $0 < G(x,x,y)$ for all $x, y \in X$ with $x \neq y$,

(G3) $G(x,x,y) \leq G(x,y,z)$ for all $x, y, z \in X$ with $y \neq z$,

(G4) $G(x,y,z) = G(x,z,y) = G(y,z,x) = \cdots$ (symmetry in all three variables),

(G5) $G(x,y,z) \leq G(x,w,w) + G(w,y,z)$ for all $x, y, z, w \in X$ (rectangle inequality).

Then, the nonnegative real function G is called a G-metric on X. The set X together with such a generalized metric G is called a generalized metric space, or G-metric space.

Example 1.2. [2] Let X be nonempty subset of the set of real numbers. Then the function $G: X \times X \times X \to [0,\infty)$ defined as

$$G(x,y,z) = |x-y| + |x-z| + |y-z|,$$

for all $x, y, z \in X$. Then (X,G) is a G-metric space.

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Remark 1.3. Every G-metric induces a metric d_G defined by

$$d_G(x,y) = G(x,y,y) + G(y,x,x),$$

for all $x, y \in X$ ([1] and [3])

Definition 1.4. [3] Let (X,G) be a G-metric space and A, B be nonempty subsets of (X,G). Then

$$A_0 = \{x \in A : d_G(x,y) = d_G(A,B) \text{ for some } y \in B\}$$

and

$$B_0 = \{y \in B : d_G(x,y) = d_G(A,B) \text{ for some x} \in A\},$$

where

$$d_G(A,B) = \inf\{d_G(x,y) : x \in A, y \in B\}.$$

Definition 1.5. [4] Let (X,G) be a G-metric space. A circle of center $x_0 \in X$ and radius $r \in (0,\infty)$ is defined as follows:

$$C_G(x_0,r) = \{x \in X : G(x_0,x,x) = r\}.$$

Example 1.6. Let us take the G-metric space given in Example 1.2. Then we have

$$C_G(10,20) = \{0,20\}.$$

Definition 1.7. [4] Let (X,G) be a G-metric space and $C_G(x_0,r)$ be any circle on X. For a self-mapping $T : X \to X$, if $Tx = x$ for each $x \in C_G(x_0,r)$, then $C_G(x_0,r)$ is called a fixed circle of T.

In this paper, assume that $\varphi : [0,\infty) \to [0,\infty)$ is a Lebesgue-integrable mapping which is summable, that is, with finite integral on each compact subset of $[0,\infty)$, nonnegative and such that

$$\int_0^{\varepsilon} \varphi(s)ds > 0$$

for each $\varepsilon > 0$ [5].

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We recall the following function families defined in [3]:

$\Psi = \{\psi : [0,\infty) \to [0,\infty)$ such that ψ is non-decreasing and continuous$\}$,

where

$\psi(t) = 0 \Leftrightarrow t = 0$

and

$\Phi = \{\phi : [0,\infty) \to [0,\infty)$ such that ϕ is lower semi-continuous$\}$,

where

$\phi(t) > 0$, $t > 0$ and $\phi(0) \geq 0$.

Definition 1.8. [3] $f : [0,\infty) \times [0,\infty) \to$ □ is a function of C-class if f is continuous and

(1) $f(t_1, t_2) \leq t_1$,
(2) $f(t_1, t_2) = t_1 \Rightarrow t_1 = 0$ or $t_2 = 0$,

for all $t_1, t_2 \in [0,\infty)$. For some f, we have $f(0,0) = 0$.

2. MAIN RESULTS

Let A and B be two nonempty subsets of a G-metric space (X, G). Let us define a circle

$C_G(x_0, r) = \{x \in A : G(x, x, x_0) = r\}$

as the best proximity circle of $T : A \to B$ if

$d_G(x, Tx) = d_G(A, B)$,

for all $x \in C_G(x_0, r)$ [6].

Definition 2.1. Let (X, G) be a G-metric space and $T : A \to B$ be a mapping. If there exist $x_0 \in A_0$, $\psi \in \Psi$ and $\phi \in \Phi$ such that

$$d_G(u, Tx) = d_G(A, B) \Rightarrow \int_0^{\psi(G(x,x,u))} \varphi(t)\,dt \leq \int_0^{f(\psi(G(x,x,x_0)),\phi(G(x,x,x_0)))} \varphi(t)\,dt ,$$

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for all $x,u \in X$, then T is called an integral type $G-\psi-\phi-f-x_0-$proximal contractive mapping.

Proposition 2.2. If T is an integral type $G-\psi-\phi-f-x_0-$proximal contractive mapping with $x_0 \in A_0$ such that

$TA_0 \subset B_0$,

then the point x_0 is a best proximity point of T.

Proof. Let $x_0 \in A_0$. Since $TA_0 \subset B_0$, we get

$Tx_0 \in B_0$.

By the hypothesis, there exists $u \in A$ such that

$$d_G(u,Tx_0) = d_G(A,B)$$

and we obtain

$$\int_0^{\psi(G(x_0,x_0,u))} \varphi(t)\,dt \leq \int_0^{f(\psi(G(x_0,x_0,x_0)),\phi(G(x_0,x_0,x_0)))} \varphi(t)\,dt$$

$$\leq \int_0^{\psi(G(x_0,x_0,x_0))} \varphi(t)\,dt = \int_0^0 \varphi(t)\,dt = 0.$$

Hence, we have

$G(x_0,x_0,u) = 0 \Rightarrow u = x_0$.

Consequently, we get

$$d_G(x_0,Tx_0) = d_G(A,B)$$

and so the point x_0 is a best proximity point of T. □

Theorem 2.3. Let the number r be defined as

$$r = \inf\left\{\frac{G(x,x,u)}{2} : x,u \in A, x \neq u\right\}.$$

If T is an integral type $G-\psi-\phi-f-x_0-$proximal contractive mapping with $x_0 \in A_0$ such that

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$TA_0 \subset B_0$

and

$C_G(x_0, r) \subset A_0,$

then the circle $C_G(x_0, r)$ is a best proximity circle of T.

Proof. Let us consider the following two cases:

If $r = 0$, then we have

$C_G(x_0, r) = \{x_0\}$

and so the point x_0 is a best proximity point of T.

Let $r > 0$ and $x \in C_G(x_0, r)$. By the hypothesis, we get

$Tx \in B_0$

and so there exists $u \in A$ such that

$d_G(u, Tx) = d_G(A, B)$

and

$$\int_0^{\psi(G(x,x,u))} \varphi(t)\,dt \le \int_0^{f(\psi(G(x,x,x_0)),\phi(G(x,x,x_0)))} \varphi(t)\,dt$$

$$\le \int_0^{\psi(G(x,x,x_0))} \varphi(t)\,dt = \int_0^{\psi(r)} \varphi(t)\,dt \le \int_0^{\psi\left(\frac{G(x,x,x_0)}{2}\right)} \varphi(t)\,dt,$$

which is a contradiction. Consequently, it should be

$d_G(x, Tx) = d_G(A, B)$

and hence the circle $C_G(x_0, r)$ is a best proximity circle of T. □

Example 2.4. Let $X = [0, \infty)$ and the function $G : X \times X \times X \to [0, \infty)$ be a G-metric defined as

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$$G(x,y,z)=\frac{1}{4}\left(|x-y|+|y-z|+|x-z|\right),$$

for all $x,y,z\in X$. Let $A=\{11,12\}$ and $B=\{10,13,14,15\}$. Let us define $T:A\to B$ as

$$Tx=\begin{cases}10 & , \quad x=11\\ 13 & , \quad x=12\end{cases}.$$

Hence, we get

$d_G(A,B)=1$, $A_0=A$, $B_0=\{10,13\}$ and $TA_0=\{10,13\}\subset B_0=\{10,13\}$.

Then, T is an integral type $G-\psi-\phi-f-x_0-$proximal contractive mapping with $x_0=12$, $\psi\in\Psi$ and $\phi\in\Phi$. Also, we have

$r=\frac{1}{2}$ and $C_G\left(12,\frac{1}{2}\right)=\{11\}$.

Consequently, the point $x_0=12$ is a best poximity point of T and the circle $C_G\left(12,\frac{1}{2}\right)$ is a best proximity circle of T.

Remark 2.5. In this study, we were primarily inspired by the results presented in references [1] and [6]. Thus, through the results we have obtained, we have provided a new perspective and alternative findings to the fixed-circle problem discussed in reference [7].

3. CONCLUSION

In this study, we established a new best proximity circle result in the framework of G-metric spaces by employing a geometric approach together with integral-type contractive conditions. The obtained results extend and generalize several existing contributions in the literature by combining geometric insights with integral inequalities. Furthermore, the proposed approach provides a broader perspective for analyzing non-self mappings in generalized metric spaces. We believe that these findings may inspire further research on geometric structures and proximity problems in more generalized settings.

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KONİ METRİK UZAYLARDA α. DERECEDEN λ-İSTATİSTİKSEL YAKINSAKLIK (λ-STATISTICAL CONVERGENCE OF ORDER α IN CONE METRIC SPACES)

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ÖZET

Koni metrik uzaylar, klasik metrik uzayların bir genellemesidir. Koni metrik uzaylarda uzaklık fonksiyonu, klasik metrik uzaylardan farklı olarak reel sayılar yerine koni tarafından belirlenen kısmi sıralama yardımıyla tanımlanır. Öte yandan, istatistiksel yakınsaklık yoğunluk hesabı ile yakınsaklığa daha esnek bir yaklaşım sunduğu için klasik yakınsaklığın bir genellemesidir ve daha geniş bir dizi sınıfını kapsar. Bu nedenlerden dolayı, bu çalışma koni metrik uzaylarda istatistiksel yakınsaklık kavramına odaklanmaktadır. Bu çalışmada, koni metrik uzaylarda α. dereceden λ-istatistiksel yakınsaklık kavramını tanıtıyoruz ve α. dereceden λ-istatistiksel yakınsaklık ile ilgili kapsama teoremleri vererek bazı ilişkileri inceliyoruz.

ABSTRACT

Cone metric spaces are a generalization of classical metric spaces. In cone metric spaces, the distance function is defined using partial ordering determined by the cone, instead of real numbers, unlike in classical metric spaces. On the other hand, statistical convergence is given as a generalization of classical convergence because it offers a more flexible approach to convergence through density calculation and covers a wider class of sequences. For these reasons, this study focuses on the concept of statistical convergence in cone metric spaces. In this study, we introduce the concept of λ-statistical convergence of order α in cone metric spaces and examine some relationships by giving inclusion theorems related to λ-statistical convergence of order α.

Anahtar Kelimeler: istatistiksel yakınsaklık, metrik uzaylar, koni metrik uzaylar.

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NONLINEAR DYNAMICAL SYSTEMS ANALYSIS FOR CHAOTIC BEHAVIOR PREDICTION IN IRANIAN HYDROLOGICAL MODELS

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ABSTRACT

This research applies nonlinear dynamical systems theory to predict chaotic behavior in Iranian hydrological models, focusing on river discharge and reservoir dynamics. The study develops a state-space representation of hydrological systems incorporating rainfall–runoff relationships, evaporation, and infiltration as nonlinear feedbacks. Using Lyapunov exponents, bifurcation diagrams, and phase-space reconstruction, the authors identify regions of deterministic chaos under certain parameter combinations, particularly in snowmelt-dominated catchments. The model reveals that small changes in initial conditions or climatic forcing can lead to qualitatively different long-term discharge trajectories, consistent with the sensitive dependence on initial conditions characteristic of chaotic systems. The paper also integrates Poincaré sections to detect periodic windows within the chaotic regime, clarifying the transition from regular to irregular hydrological behavior. The findings are validated against time-series data from major Iranian river basins, where the nonlinear framework improves short-term flood forecasting performance compared with classical linear autoregressive approaches. The study highlights the implications of this analysis for water-resources management, emphasizing that chaotic dynamics impose inherent limits on long-term predictability and arguing for the design of robust, adaptive control strategies rather than long-horizon deterministic forecasts. The work contributes to the broader understanding of complex natural systems by demonstrating how tools from nonlinear dynamics can enhance the interpretation and prediction of hydrological behavior in arid and semi-arid environments.

Keywords: nonlinear dynamics, hydrological modeling, chaos theory, Lyapunov exponents, water resources

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FRACTIONAL CALCULUS APPLICATIONS IN OPTIMIZING IRANIAN RENEWABLE ENERGY GRIDS

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ABSTRACT

This study investigates the application of fractional-order calculus to improve the modeling and control of Iranian renewable energy grids, particularly those integrating wind and solar power. The work formulates the dynamic response of power-grid components, including converters, inverters, and energy storage, using fractional differential equations, which capture memory and hereditary effects in system behavior better than integer-order models. The authors design fractional-order controllers for automatic voltage regulators and frequency regulators and demonstrate their superior performance in damping oscillations, minimizing control error, and enhancing robustness against parameter uncertainty when compared with classical PID regulators. The analysis is carried out on a model of a hybrid grid incorporating variable-speed wind turbines and photovoltaic systems, with emphasis on transient stability during load changes and renewable-generation fluctuations. Simulation results show that the proposed fractional-order control framework improves voltage regulation and reduces frequency deviation, thereby contributing to the reliability and efficiency of the grid. The study also discusses practical implementation issues, such as discretization of fractional operators and tuning of non-integer controller parameters, and proposes guidelines for engineers working on renewable-energy integration in national transmission networks. The research provides a theoretical and practical framework for extending fractional-order methods to large-scale energy systems, supporting the transition toward sustainable and resilient power infrastructure.

Keywords: fractional calculus, renewable energy grids, fractional-order control, power system stability, electrical engineering

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GRAPH THEORY APPROACHES TO ALBANIAN URBAN TRANSPORTATION NETWORK OPTIMIZATION

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ABSTRACT

This paper presents graph-theoretic methods for optimizing urban transportation networks in Albanian cities, focusing on public-transit and road-network efficiency. The transportation system is represented as a weighted graph, where vertices correspond to intersections or transit stops and edges represent streets or bus routes, with weights reflecting travel time, congestion, or passenger demand. The authors apply shortest-path algorithms, centrality measures, and flow optimization techniques to identify critical bottlenecks, redundant routes, and underutilized corridors. The study examines how modifications such as the introduction of dedicated bus lanes, route reconfiguration, or junction rationalization affect network connectivity and travel-time distribution. The results illustrate how graph-based optimization can reduce average travel time and improve service coverage without major infrastructure expansion. The paper also discusses the integration of multimodal data, including pedestrian and bicycle flows, into the graph model to support sustainable urban mobility. The approach is illustrated through case studies of selected Albanian urban centers, demonstrating how small topological adjustments can significantly enhance network resilience and equity of access. This work contributes to transportation planning practice by providing a formal, scalable methodology for evaluating and improving urban transport networks within the context of compact cities and limited budgets.

Keywords: graph theory, urban transportation, network optimization, centrality measures, sustainable mobility

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NUMBER THEORY INVESTIGATIONS INTO ALBANIAN CRYPTOGRAPHIC SECURITY PROTOCOLS

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ABSTRACT

This research explores the role of modern number theory in the security of cryptographic protocols used within Albanian information systems. The work emphasizes algebraic foundations of public-key cryptography, including the hardness of factoring, discrete logarithms, and elliptic-curve discrete logarithm problems, and explains how these mathematical problems underpin the design of key-exchange mechanisms, digital signatures, and encryption schemes. The authors review selected Albanian standards and implementations, analyzing the choice of modulus length, prime generation, and curve parameters in relation to current cryptanalytic advances. The study also considers the transition toward post-quantum cryptographic primitives based on lattice problems and multivariate polynomial systems, discussing the theoretical advantages and trade-offs in terms of efficiency and implementation complexity. The paper highlights the importance of rigorous parameter selection, secure key management, and standardized testing procedures to prevent practical vulnerabilities despite sound theoretical assumptions. By linking classical number-theoretic problems with concrete cryptographic use cases, the study contributes to both theoretical understanding and practical guidance for national cryptographic policy, emphasizing the need for continuous security evaluation as computing capabilities evolve. The work underlines the critical role of mathematics in maintaining the integrity and confidentiality of digital communications in the public and private sectors.

Keywords: number theory, cryptography, public-key systems, post-quantum cryptography, security protocols

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STOCHASTIC PROCESSES MODELING FOR RUSSIAN FINANCIAL MARKET VOLATILITY FORECASTING

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ABSTRACT

This study develops stochastic-process models to forecast volatility in Russian financial markets, focusing on equity indices and foreign-exchange time series. The authors employ continuous-time diffusion processes, including geometric Brownian motion and GARCH-type representations, to describe the evolution of asset prices and conditional variance. The analysis incorporates jumps and regime switches to capture structural breaks associated with macroeconomic events, sanctions, and policy shifts, which are particularly relevant for the Russian context. Parameter estimation is performed using maximum-likelihood and Bayesian methods, and the models are validated against realized volatility measures computed from high-frequency data. The paper demonstrates that stochastic volatility frameworks, especially those allowing time-varying volatility and leptokurtic return distributions, outperform simple historical-volatility benchmarks in out-of-sample forecasting. The study also discusses implications for risk management, portfolio optimization, and derivatives pricing, emphasizing that accurate volatility forecasts are essential for realistic assessment of value-at-risk and option-pricing models. The research contributes to the broader literature on emerging-market finance by illustrating how general stochastic approaches can be adapted to specific national contexts characterized by higher volatility and frequent structural change. The findings suggest that well-calibrated stochastic models can enhance the quantitative tools available to investors and regulators operating in the Russian financial system.

Keywords: stochastic processes, volatility forecasting, financial markets, GARCH models, risk management

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TOPOLOGICAL DATA ANALYSIS FOR RUSSIAN BIOMEDICAL IMAGE PROCESSING ALGORITHMS

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ABSTRACT

This research applies topological data analysis (TDA) to biomedical image processing, with applications to Russian clinical imaging datasets. The work represents images or their segmentations as high-dimensional point clouds and uses persistent homology to extract topological features such as connected components, loops, and voids that characterize tissue structures, lesion shapes, and vascular networks. The authors develop TDA-based pipelines for dimensionality reduction, denoising, and anomaly detection in MRI and CT scans, demonstrating how topological fingerprints can enhance the discrimination between healthy and pathological tissue. The study compares the TDA-augmented approach with classical feature-engineering methods, showing improved robustness to noise and partial artifacts. The paper also discusses the integration of TDA features into machine-learning classifiers, where the topological descriptors act as complementary inputs to intensity- and texture-based features. The framework is illustrated with case studies from oncology and neurology, including the characterization of tumor heterogeneity and cortical folding patterns. The work emphasizes the interpretability of topological descriptors, which can reflect underlying biological structures and support radiologists' decision-making. This research contributes to the methodological toolbox of computational medical imaging by demonstrating how topology-driven techniques can complement existing computer-vision pipelines and improve the accuracy and interpretability of diagnostic support systems.

Keywords: topological data analysis, persistent homology, biomedical imaging, machine learning, medical diagnostics

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DIFFERENTIAL EQUATIONS SOLUTIONS FOR EGYPTIAN POPULATION GROWTH PROJECTIONS

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ABSTRACT

This paper uses differential equation models to study population growth dynamics and project future demographic trends in Egypt. The authors begin with the classical Malthusian and Verhulst logistic models, then extend the framework to include age-structured and spatially distributed components relevant to the Egyptian context. The analysis considers birth and death rates, migration, urbanization, and public-health interventions as key driving forces shaping population trajectories. The work pays particular attention to the role of carrying capacity and resource constraints, drawing on national statistics to estimate parameters and calibrate the models. The projected outcomes distinguish between scenarios of continued high fertility, progressive fertility decline, and policy-induced changes in age composition. The study also discusses the interplay between population growth, labor-force dynamics, and urban expansion, highlighting implications for social services, housing, and infrastructure planning. The findings indicate that without significant shifts in fertility and family-planning adoption, Egypt will face increasing pressure on existing resources, whereas controlled growth scenarios can support more sustainable development. The research demonstrates how dynamical modeling provides a rigorous, quantitative basis for long-term demographic planning and policy design, emphasizing the importance of integrating demographic analysis with economic and social-policy considerations.

Keywords: differential equations, population growth, demographic modeling, logistic growth, age-structured dynamics

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NONLINEAR DYNAMICAL SYSTEMS ANALYSIS FOR PREDICTING CHAOTIC BEHAVIOR IN ALGERIAN DESERT ECOSYSTEMS

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ABSTRACT

This study investigates the use of nonlinear dynamical systems to model and predict chaotic behavior in Algerian desert ecosystems, characterized by fragile ecological equilibria and high environmental variability. The research develops a set of differential equations describing interactions between vegetation, soil moisture, and animal populations under fluctuating climatic conditions. By analyzing attractors, bifurcation diagrams, and Poincaré sections, the study identifies parameter regions where small changes in rainfall or grazing intensity push the system into chaotic regimes, leading to abrupt and unpredictable ecological transitions. The models incorporate time delays and feedback structures to capture memory effects in plant and soil processes, which are essential for accurately reproducing field observations from arid regions of the Algerian Sahara. The study also examines the role of external perturbations, including climate change scenarios and land-use practices, on the stability and resilience of these ecosystems. Theoretical tools such as Lyapunov exponents and fractal dimension estimates are employed to characterize the degree of chaos and to distinguish between deterministic unpredictability and stochastic noise. The results highlight the importance of early-warning indicators, such as increased variance and slowing of recovery rates, in detecting approaching regime shifts. The findings are discussed in the context of ecological management, showing how nonlinear analysis can inform conservation strategies, grazing regulations, and land restoration initiatives in arid environments. The study concludes that treating desert ecosystems as nonlinear dynamical systems significantly improves the capacity to anticipate and mitigate the risks associated with chaotic ecological behavior.

Keywords: nonlinear dynamics, desert ecosystems, chaos theory, ecological modeling, early-warning indicators

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OPTIMAL CONTROL THEORY APPLICATIONS IN ALGERIAN WATER RESOURCE MANAGEMENT MODELS

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ABSTRACT

This research explores the application of optimal control theory to the design and analysis of water resource management models in the context of Algeria's arid and semi-arid regions. The study develops a dynamic optimization framework to allocate water between competing sectors, including agriculture, domestic consumption, and industrial production, while taking into account hydrological uncertainties and climate variability. The control problem is formulated using state variables such as reservoir storage, groundwater levels, and river flows, and decision variables such as release rules, allocation policies, and inter-basin transfers. The objective functional incorporates multiple criteria, including economic benefits, ecological flows, and social equity, reflecting the trade-offs inherent in water governance. The analysis is based on Pontryagin's maximum principle, yielding closed-form or numerically computed control strategies that minimize long-term costs while preserving system stability. The models are tested with data from major Algerian river basins and compared to existing operational rules, demonstrating that optimal control strategies improve water availability during droughts and reduce over-extraction in wet periods. The study also discusses the role of adaptive and robust control methods in handling structural and parametric uncertainty, including changes in precipitation patterns and demand growth. The results are interpreted in terms of policy implications, showing how optimal control theory can guide the design of reservoir operating rules, drought mitigation plans, and transboundary water agreements. The conclusion emphasizes the potential of integrating mathematical optimization into national water policies to enhance sustainability and resilience in water-scarce environments.

Keywords: optimal control, water resource management, hydrological modeling, reservoir operations, climate adaptation

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FRACTIONAL CALCULUS METHODS FOR SOLVING HEAT TRANSFER EQUATIONS IN INDIAN INDUSTRIAL PROCESSES

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ABSTRACT

This study investigates the use of fractional calculus to model transient heat transfer phenomena in industrial systems, especially in manufacturing, thermal processing, and energy applications characterized by complex thermal histories and memory-dependent transport mechanisms. The classical Fourier law is extended to fractional-order derivatives, allowing the representation of nonlocal and anomalous heat diffusion observed in heterogeneous materials such as composites, porous media, and multilayer structures. The research formulates fractional diffusion equations with Caputo and Riemann–Liouville operators, and compares the resulting solutions to experimental temperature profiles obtained from industrial-scale heat exchangers, furnaces, and heat treatment chambers. The fractional models are shown to provide closer agreement with measured data, particularly in cases where thermal pulses, delayed responses, or long-term memory effects dominate the behavior. The study also develops analytical and semi-analytical techniques, including Laplace transforms, integral methods, and spectral approximations, to solve the fractional boundary-value problems. Numerical schemes based on finite differences and finite elements are implemented to simulate large-scale industrial geometries, and the computational efficiency and accuracy are assessed. The work evaluates the physical implications of the fractional order, relating it to microstructural features such as pore connectivity, interfacial resistance, and fractal grain arrangements. The results are discussed within the context of industrial optimization, demonstrating how fractional heat transfer models can improve thermal design, process control, and energy efficiency assessments. The study concludes that fractional calculus offers a mathematically rigorous and physically interpretable framework for extending the scope of classical heat transfer theory in industrial applications.

Keywords: fractional calculus, heat transfer, anomalous diffusion, industrial processes, thermal modeling

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GRAPH THEORY ALGORITHMS FOR NETWORK OPTIMIZATION IN INDIAN TRANSPORTATION SYSTEMS

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ABSTRACT

This study applies graph theory and discrete optimization techniques to improve the design and operation of transportation networks in Indian metropolitan and inter-city contexts. The research formulates transportation systems as directed and weighted graphs, where nodes represent junctions, terminals, or stations, and edges encode travel times, distances, or capacities, possibly augmented by stochastic or time-dependent attributes. The study analyzes several combinatorial optimization problems, including shortest path, minimum-cost flow, multi-commodity flows, and network reconfiguration, using algorithms such as Dijkstra's, Ford–Fulkerson, and metaheuristic approaches. The models are adapted to practical constraints such as traffic congestion, infrastructure bottlenecks, multimodal transfers, and incomplete information, often through heuristic rules and data-driven refinements. The research integrates empirical traffic data, public transit timetables, and freight logistics information to calibrate the network parameters and validate the performance of the proposed algorithms. The study demonstrates how optimized routing and scheduling can reduce travel times, enhance connectivity, and balance traffic loads across the network, thereby improving user experience and reducing operational costs. The analysis also considers equity and accessibility, assessing how network improvements affect different socio-economic groups and regions. The results are interpreted in terms of planning and policy implications, showing how graph-theoretic methods can support urban planning, logistics management, and infrastructure investment decisions. The study concludes that graph theory provides a flexible and powerful mathematical language for modeling and improving transportation networks, with applications ranging from route planning to large-scale urban mobility strategies.

Keywords: graph theory, network optimization, transportation systems, routing algorithms, urban mobility

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STOCHASTIC PROCESSES MODELING FOR KAZAKHSTANI FINANCIAL MARKET VOLATILITY PREDICTION

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ABSTRACT

This study examines the use of stochastic processes to model and forecast volatility in the financial markets of Kazakhstan, focusing on equity indices, currency exchange rates, and bond yields. The research develops continuous-time stochastic models, including geometric Brownian motion, GARCH-type structures, and diffusion processes with jumps, to capture the random fluctuations that characterize financial returns. The models are calibrated to historical data from the Kazakhstan Stock Exchange and the national interbank market, using maximum likelihood and Bayesian estimation techniques. The analysis pays particular attention to volatility clustering, leptokurtic return distributions, and regime shifts driven by macroeconomic news, policy changes, and global market developments. The study evaluates the performance of the models in forecasting future volatility, and compares them with simpler moving-average and historical volatility estimators, as well as with machine-learning benchmarks. The results show that stochastic models based on continuous-time processes provide more accurate and robust volatility forecasts, especially during periods of market stress and regime transition. The study also discusses the role of implied volatility, extracted from options and forward contracts, in refining the models and enhancing market risk assessment. The findings are interpreted within the context of financial risk management, demonstrating how the volatility models can inform portfolio optimization, option pricing, and regulatory capital requirements. The conclusion emphasizes the importance of tailoring stochastic process models to the specific institutional and macroeconomic context of emerging markets like Kazakhstan.

Keywords: stochastic processes, financial volatility, volatility modeling, risk management, emerging markets

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NUMERICAL SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS IN KAZAKH PETROLEUM RESERVOIR SIMULATIONS

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ABSTRACT

This study addresses the numerical simulation of multiphase fluid flow in petroleum reservoirs using partial differential equations derived from conservation laws of mass, momentum, and energy. The governing equations, which include generalized Darcy's equations and coupled transport equations for oil, water, and gas, are discretized using finite-volume and finite-element methods in three-dimensional heterogeneous geometries. The research focuses on improving the accuracy and computational efficiency of numerical schemes for handling strong nonlinearities, phase mobility variations, and capillary pressure effects. The study compares different discretization strategies, including upstream weighting, mixed finite elements, and adaptive mesh refinement, in terms of their stability, convergence rates, and ability to preserve physical constraints such as mass conservation and phase saturation bounds. The simulations are validated against synthetic benchmarks and historical field data from major Kazakh oilfields, demonstrating the ability of the models to reproduce production profiles and pressure responses. The research also investigates the impact of geological uncertainty on simulation outcomes, using sensitivity analyses and stochastic reservoir characterization methods. The results are discussed in the context of reservoir management, showing how numerical simulations can guide drilling plans, production optimization, and enhanced oil recovery projects. The study concludes that advanced numerical methods for partial differential equations provide a robust foundation for computer-assisted reservoir engineering, enabling more reliable and economically informed decision-making in the petroleum sector.

Keywords: reservoir simulation, multiphase flow, finite-volume methods, porous media, numerical modeling

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DIFFERENTIAL GEOMETRY APPLICATIONS IN ANALYZING GREEK ANCIENT ARCHITECTURAL STRUCTURES

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ABSTRACT

This study explores the application of concepts and methods from differential geometry to the analysis of ancient Greek architectural structures, including temples, theaters, and monumental complexes. The research reconstructs the spatial configuration of selected edifices as smooth surfaces or manifolds, described by metric tensors and curvature functions, and investigates how the local geometry relates to structural stability, visual perception, and aesthetic harmony. The study examines the role of curvature, torsion, and other geometric invariants in shaping roof geometries, column fluting, and entablature proportions, showing how subtle geometric choices influence both mechanical performance and sensory experience. The analysis draws on historical and archaeological data, including stonecutting techniques, material properties, and construction sequences, to interpret the geometric designs in their technical and cultural context. The work also considers how symmetry groups, ruled surfaces, and minimal surfaces are implicitly encoded in classical orders and in the spatial organization of sacred precincts. The results contribute to the ongoing discussion on the interplay between mathematics and architecture in antiquity, demonstrating that differential geometry provides a rigorous framework for describing the sophisticated spatial thinking of ancient Greek architects. The study concludes that geometric analysis can enhance the understanding of conservation issues, restoration strategies, and the interpretation of architectural form in the heritage of ancient Greece.

Keywords: differential geometry, ancient Greek architecture, architectural surfaces, curvature analysis, architectural conservation

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FUNCTIONAL ANALYSIS TECHNIQUES FOR QUANTUM MECHANICS PROBLEMS IN GREEK RESEARCH

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ABSTRACT

This study examines the role of functional analysis in the formulation and solution of key problems in quantum mechanics, as reflected in contemporary research activities in Greece. The research focuses on operator theory in Hilbert spaces, spectral analysis, and the mathematical foundations of quantum observables, boundary value problems, and quantum evolution. The study reviews the treatment of unbounded self-adjoint operators, their spectral decomposition, and the associated uncertainty relations, emphasizing the connection between abstract spectral theory and measurable physical quantities. The analysis also covers the role of functional spaces, including Sobolev spaces and spaces of tempered distributions, in rigorously defining wave functions, potentials, and Green functions. The work discusses the use of compact and trace-class operators in the study of discrete spectra, scattering theory, and quantum statistical mechanics. The study illustrates these concepts with concrete problems from Greek research, such as the analysis of Schrödinger operators with nonlocal potentials, the study of Dirac systems in relativistic quantum mechanics, and quantum control schemes. The results highlight the importance of functional analytic tools for ensuring mathematical consistency, clarifying physical interpretations, and developing new approximation and numerical methods. The study concludes that functional analysis remains an indispensable component of the theoretical physicist's toolkit, providing a unified language for treating diverse quantum phenomena in a coherent and rigorous way.

Keywords: functional analysis, quantum mechanics, operator theory, Hilbert spaces, spectral analysis