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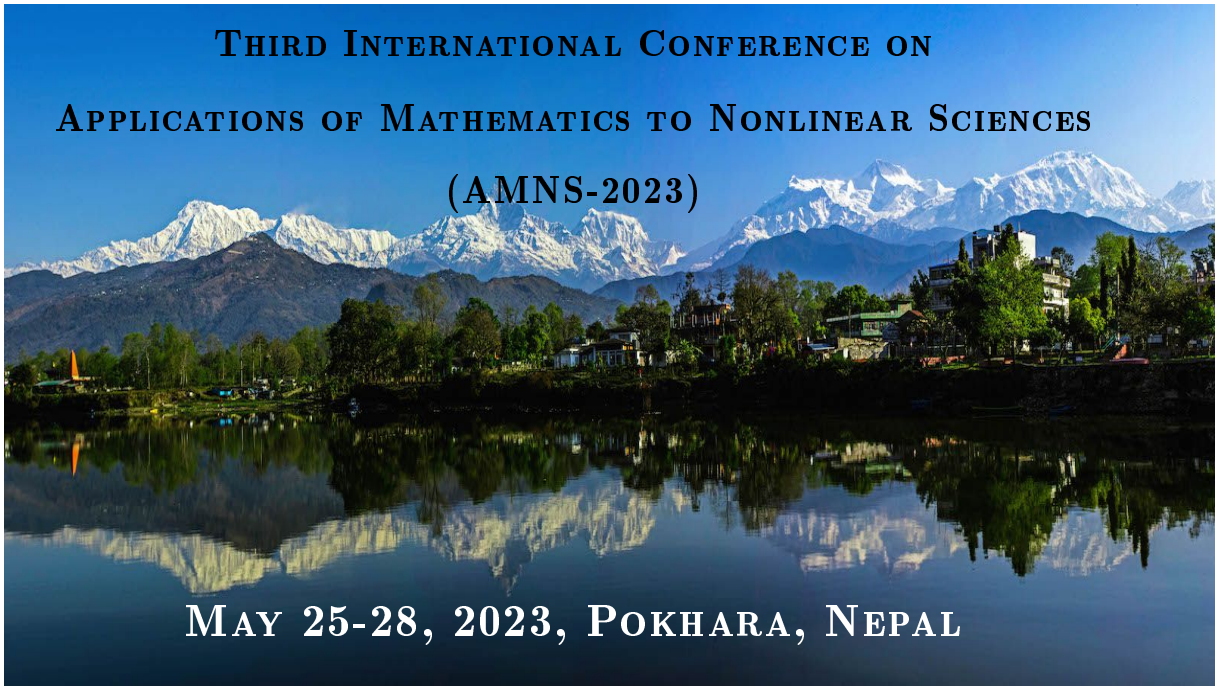
Book of Abstracts



Conference Organizers

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Book of Abstracts

Third International Conference on Applications of Mathematics to Nonlinear Sciences (AMNS-2023)

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Editors
Ishwari Kunwar, Gokarna Aryal, Dhruba Adhikari

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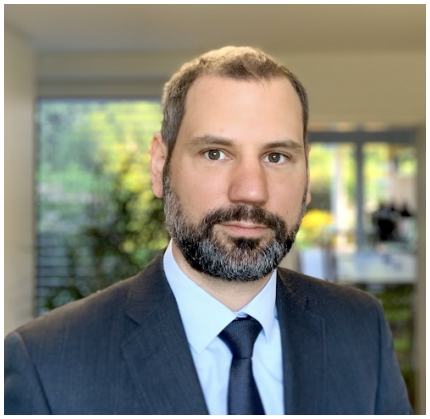
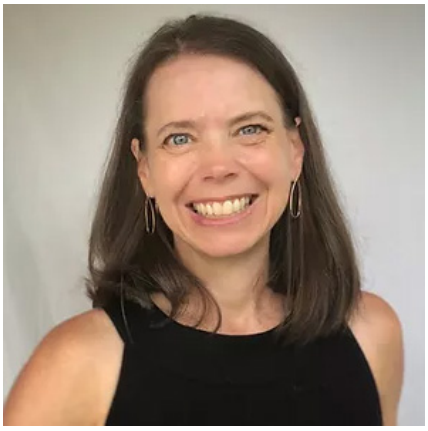


Till Becker is a Professor of Information Systems at the University of Applied Sciences Emden/Leer in Germany. His research focuses on complex networks in manufacturing and logistics, data science and artificial intelligence in business applications, and the ongoing digitalization of industry. His work has been published in leading international journals such as the International Journal of Production Economics and the Journal of Manufacturing Systems. Before joining the University of Applied Sciences Emden/Leer, he was head of the junior research group 'Production and Logistics Systems' at the Department of Production Engineering and at the Bremer Institut für Produktion und Logistik GmbH (BIBA) at the University of Bremen, Germany.



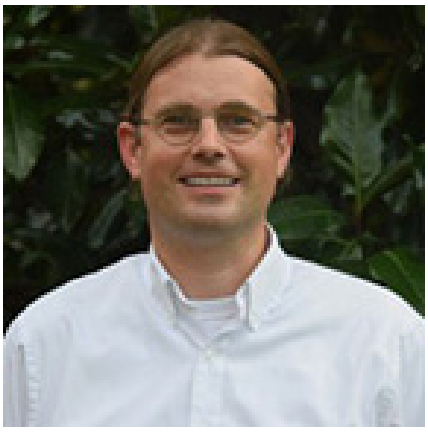
Amy B. Ellis is a Professor of Mathematics Education at the University of Georgia. She received her Ph.D. from the joint program at the University of California, San Diego and San Diego State University. She also holds a bachelor's and master's degree in mathematics. Prior to her appointment at the University of Georgia, she taught middle-school and high school mathematics, and then spent 12 years as a professor at the University of Wisconsin. In her current position she enjoys working with secondary mathematics teachers.

Dr. Ellis's scholarship addresses students reasoning and learning, particularly as it relates to algebra, generalization, and proof, as well as teachers' pedagogical practices aimed at fostering meaningful student engagement. She also studies playful math, investigating ways to support students' playful engagement with mathematical ideas in order to foster productive mathematical dispositions. She has received fifteen grants from national and state organizations, including the National Science Foundation and the Institute of Education Sciences, and has received awards recognizing her scholarship, including the Early Career Publication Award from the American Educational Research Association and the Yeany Research Award. Dr. Ellis has published her work in Science, the Journal for Research in Mathematics Education, Educational Studies in Mathematics, Cognition and Instruction, and the Journal of the Learning Sciences, among others, and she has published three books for the National Council of Teachers of Mathematics Essential Understanding Series

Irene Fonseca is the Kavčić-Moura University Professor of Mathematics in the Department of Mathematical Sciences at Carnegie Mellon University, USA, where she is the Director of the Center for Nonlinear Analysis (CNA). Irene Fonseca has supervised 17 Ph.D. students and mentored 42 postdoctoral fellows. She is a Fellow of the American Mathematical Society (AMS), a Fellow of the Society for Industrial and Applied Mathematics (SIAM), a Fellow of the European Academy of Sciences, and she was elected to the Academy of Sciences of Lisbon (Portugal). She was SIAM President in 2013 and 2014. She is a Grand Officer of the Military Order of Saint James of the Sword (Grande Oficial da Ordem Militar de Sant'Iago da Espada, Portuguese Decoration). She serves in 20 Editorial Boards, including Advances in Calculus of Variations, Archive for Rational Mechanics and Analysis, Communications of the AMS (CAMS), ESAIM:COCV (SMAI), Journal of Nonlinear Science, Mathematical Models and Methods in Applied Sciences (M3AS), and SIAM Journal on Mathematical Analysis. She is a member of several advisory and scientific boards of research centers and institutes, she participates in international prize committees, and is in review and evaluation panels of multiple universities in the US and abroad.

Irene Fonseca's main contributions have been on the variational study of ferroelectric and magnetic materials, composites, thin structures, phase transitions, and on the mathematical analysis of image segmentation, denoising, detexturing, registration and recolorization in computer vision. Her research program continues to explore modern methods in the calculus of variations motivated by problems issuing from materials science and imaging science.

Alun Lloyd is a Professor of Biostatistics at North Carolina State University USA. He is a mathematical biologist. The majority of his work concerns the epidemiology of infectious diseases, with a particular recent interest in mosquito-borne infections. He is the Associate Dean for Academic Affairs in the College of Sciences, NC State University. He also retains a position in the Department of Mathematics at North Carolina State University, where he is Drexel Professor of Mathematics. He also currently directs the Biomathematics Graduate Program.



He studied mathematics at Trinity College, Cambridge, before moving to the Department of Zoology in Oxford to do a Ph.D. with Robert May, which he completed in 1996. In 1999 he moved to the US, for a four year stint as a Long-Term Member in the Institute for Advanced Study's Program in Theoretical Biology. He moved to NC State faculty position in 2003.

Bhramar Mukherjee is John D. Kalbfleisch Collegiate Professor and Chair of Biostatistics; Professor of Epidemiology and Global Public Health, University of Michigan School of Public Health; She also serves as the Associate Director for Quantitative Data Sciences, The University of Michigan Rogel Cancer Center. Her research interests include statistical methods for analysis of electronic health records, studies of gene-environment interaction, Bayesian methods, shrinkage estimation, analysis of high dimensional exposure data. Bhramar and her team took an active role in modeling the SARS-CoV-2 virus trajectory in India during the pandemic, with the research being covered by major media outlets like Reuters, BBC, NPR, NYT, WSJ, Der Spiegel, Australian National Radio and the Times of India. She has co-authored more than 350 articles in statistics, biostatistics, medicine, and public health. She is the founding director of the University of Michigan's summer institute on Big Data. Bhramar is a fellow of the American Statistical Association and the American Association for the Advancement of Science. She is the recipient of many awards for her scholarship, service and teaching at the University of Michigan and beyond: including the Gertrude Cox Award from the Washington Statistical Society in 2016, the L. Adrienne Cupples Award, from Boston University in 2020. In 2021 she was presented with the Distinguished Woman Scholar Award from Purdue University, the Janet L. Norwood award from the University of Alabama at Birmingham, the Sarah Goddard Power Award from the University of Michigan Academic Women's Caucus, and most recently, in 2022 she was Elected as a Member of the US National Academy of Medicine.

Zhou-Ping Xin is a professor in the Department of Mathematics at Chinese University of Hong Kong, Hong Kong. He is an expert in the areas of partial differential equations, mathematical physics, fluid mechanics, nonlinear waves, numerical analysis and numerical methods for PDEs and applied mathematics. He has made some substantial contributions to the nonlinear stability theory of linear and nonlinear waves (including viscous shocks and rarefaction waves), boundary layer theory, multi-dimensional shock wave theory and hyperbolic conservation laws, transonic flows and mixed type nonlinear partial differential equations, interfacial wave motions and free boundary problems in fluid dynamics, vacuum dynamics, vortex methods and relaxation methods, multi-sclae analysis, and multi-dimensional compressible and incompressible Navier-Stokes systems, etc., with more than one hundred eighty publications in leading international research journals. After he got his Ph.D. in mathematics from the University of Michigan (Ann Arbor) in 1988, Professor Xin became a Courant instructor at The Courant Institute of New York University, where he was promoted to be a full professor of mathematics in 1995. In 2000, Professor Xin moved from the New York University to the Chinese University of Hong Kong where he has been the William M. W. Mong Professor of Mathematics and the executive director of the Institute of Mathematical Sciences. Professor Xin got many honors including: Sloan Research Fellow (1991-1993, USA), Presidential Fellow (1993, NYU, USA); ICM invited speaker (2002); and Morningside Gold Medalist in Mathematics (2004), etc. Professor Xin is the co-editor-in-chief of MAA, associated editor of JMP and M2AS, and member of the editorial boards for many journals such as M3AS, Kyoto J. Math, Sciences China Mathematics, JHDE, etc. Professor Xin was the president of Hong Kong Mathematical Society from 2012-2016.

Plenary (PL)

PL1: **Till Becker**, University of Applied Sciences Emden/Leer, Germany

Title: **Current Developments in Data Science, Analytics, and AI from a Business Perspective**

Email: till.becker@hs-emden-leer.de

Abstract: The talk will explore the interdisciplinary nexus of data science, analytics, AI, and optimization methodologies in today's business landscape. By leveraging the increasing availability of data and cutting-edge AI technologies, organizations are advancing decision-making processes, refining customer experiences, and optimizing operational efficiencies. The focus will be on real-world applications of data analytics, modeling, and optimization algorithms, combined with an analysis of the projected evolution of business applications in these areas. This includes the practical implications and transformative potential of data-driven strategies and optimization techniques across industries.

PL2: **Amy B. Ellis**, University of Georgia, USA

Title: **Playful Math, Conjecturing, and Generalizing**

Email: amyellis@uga.edu

Abstract: Mathematical play offers opportunities for students to exercise agency and engage in meaningful exploration, and studies of mathematical play show positive outcomes for motivation, enjoyment, and learning. Furthermore, authentic disciplinary engagement involves many of the same features as play, and professional mathematicians have been shown to engage in mathematical play as part of their practice. The current research base on mathematical play is largely situated either in early childhood/elementary school, or in informal settings such as video games or makerspaces. These studies investigate how play can be mathematized, examining the mathematics that arises from play. I consider the reverse direction, that of "playifying" the school mathematics that students and teachers must navigate in classroom contexts. In doing so, I will share findings about mathematicians', undergraduates', and middle-school students' playful math engagement. In particular, our studies show that playful math tasks can improve students' goal selection, agency, and investment, as well as support their development of conjectures and generalizations. I will present three cases of playful math activity and discuss how playful math can support students' authentic disciplinary engagement.

PL3: **Irene Fonseca**, Carnegie Mellon University, USA

Title: **Phase Separation in Heterogeneous Media**

Email: fonseca@andrew.cmu.edu

Abstract: Modern technologies and biological systems, such as temperature-responsive polymers and lipid rafts, take advantage of engineered inclusions, or natural heterogeneities of the medium, to obtain novel composite materials with specific physical properties. To model such situations by using a variational approach based on the Cahn-Hilliard gradient theory of phase transitions, the potential and the wells may have to depend on the spatial position, even in a discontinuous way, and different regimes should be considered. In the critical case case where the scale of the small heterogeneities is of the same order of the scale governing the phase transition and the wells are fixed, the interaction between homogenization and the phase transitions process leads to an anisotropic interfacial energy. The supercritical case for fixed wells is also addressed, now leading to an isotropic interfacial energy. In the subcritical case with moving wells, where the heterogeneites

of the material are of a larger scale than that of the diffuse interface between different phases, it is observed that there is no macroscopic phase separation and thermal fluctuations play a role in the formation of nanodomains.

This is joint work with Riccardo Cristoferi (Radboud University, The Netherlands) and Likhit Ganedi (Aachen University, Germany), USA), based on previous results also obtained with Adrian Hagerty (USA) and Cristina Popovici (USA).

PL4: **Alun Lloyd**, North Carolina State University, USA

Title: **Stochasticity and Heterogeneity in the Aedes aegypti/Dengue Transmission System: Implications for Spread and Control of Infection**

Email: alun_lloyd@ncsu.edu

Abstract: The Aedes aegypti mosquito is the vector for several infections of public health concern, including dengue, chikungunya, Zika and yellow fever. The mosquito lives in close proximity to humans, typically only disperses over short distances and its population density is often highly heterogeneous across space. As a result, the transmission dynamics of the infections it vectors are subject to significant heterogeneity which must be accounted for when modelling the spread and control of these infections. Through a series of vignettes, we will discuss some of this modelling, utilizing a number of different mathematical and simulation frameworks—from deterministic and stochastic multi-patch models through to cohort or individual-based simulation models. Pros and cons of the various approaches will be discussed.

PL5: **Bhramar Mukherjee**, University of Michigan, USA

Title: **A Data-driven framework for pandemic resilience: Lessons from modeling SARS-CoV-2 transmission dynamics in India**

Email: bhramar@umich.edu

Abstract: India, world's largest democracy, had three very different surges of SARS-CoV-2 in 2020,2021 and 2022 corresponding to the transmission of the ancestral strain, the rise of the Delta variant and the latest Omicron wave. The human behavior and public health intervention strategies were also very different during these three waves. In this presentation, we provide a brief chronicle of the modeling experience of our study team over the last three years, looking at the data from India, leading to the development of a tiered data-driven framework for public health interventions towards pandemic resilience. Through mathematical modeling we study the timing and duration of public health interventions with intervention effects estimated from actual data. We illustrate that early and sustained interventions can help us avoid harsh lockdowns and reduce COVID mortality drastically. We also quantify the estimated number of missing COVID-deaths in India which are orders of magnitude larger than reported COVID-deaths. This is joint work with many, with all supporting research materials and products available at covind19.org.

PL6: **Zhou-Ping Xin**, Chinese University of Hong Kong, Hong Kong

Title: **Free Interface Problems and Stabilizing Effects of Transversal Magnetic Fields**

Email: zpxin@ims.cuhk.edu.hk

Abstract:Dynamical interface motions are important flow patterns and fundamental free boundary problems in fluid mechanics, and have attracted huge attentions in the mathematical community. Such waves for purely inviscid fluids are subject to various instabilities such as Kelvin-Helmholtz and Rayleigh-Taylor instabilities unless other stabilizing effects such as surface tension, Taylor-sign conditions or dissipations are imposed. However, in the presence of magnetic fields, it has

been known that tangential magnetic fields may have stabilizing effects for free surface waves such as plasma-vacuum or plasma-plasma interfaces (at least locally in time), yet whether transversal magnetic fields (which occurs often for interfacial waves for astrophysical plasmas) can stabilize typical free interfacial waves remains to be some open problems. In this talk I will show the stabilizing effects of the transversal magnetic fields for some interfacial waves for both compressible and incompressible multi-dimensional magnetohydrodynamics (MHD). First, I will present the local (in time) well-posedness in Sobolev space of multi-dimensional compressible MHD contact discontinuities, which are most typical interfacial waves for astrophysical plasma and prototypical fundamental waves for systems of hyperbolic conservations. Such waves are characteristic discontinuities for which there is no flow across the discontinuity surface while **the magnetic field** crosses **transversally**, which lead to a two-phase free boundary problem that may have nonlinear Rayleigh-Taylor instability and whose front symbols have no ellipticity. We overcome such difficulties by exploiting full the transversality of the magnetic fields and designing a nonlinear approximate problem, which yield the local well-posed without loss of derivatives and without any other conditions such as Rayleigh-Taylor sign conditions or surface tension. Second, I will discuss some results on the global well-posedness of free interface problems for the incompressible inviscid resistive MHD with transversal magnetic fields. Both plasma-vacuum and plasma-plasma interfaces are studied. The global in time well-posedness of both interface problems in a horizontally periodic slab impressed by a uniform non-horizontal magnetic field near an equilibrium are established, which reveal the strong stabilizing effect of the transversal field as the global well-posedness of the free boundary incompressible Euler equations (without the irrotational assumptions) around an equilibrium is unknown.

This talk is based on joint works with Professor Yanjin Wang. The research works reported here are partially supported by Hong Kong RGC Earmarked Research Grants: CUHK14301421, CUHK14300819, CUHK14302819, CUHK14300917, and CUHK14302917.

Special Invited (SP)

SP1: **Shashidhar Belbase**, United Arab Emirates University, Al Ain, Abu Dhabi, UAE

Title: **Axiomatic Thinking: Transcending from Basic to Advanced Mathematical Constructions in School Mathematics**

Coauthors: Bishnu Khanal, Mukunda Prakash Kshetree, Bed Raj Acharya, Ram Krishna Panthi, Dirgha Raj Joshi, Yagya Prasad Gnawali

Email: sbelbase@uaeu.ac.ae

Abstract: The epistemic structure of mathematics has been constructed and advanced through fundamental assumptions, definitions, and axioms. Mathematicians, mathematics educators, and mathematics enthusiasts have contributed to the development of epistemic structures in mathematics over time using those basic concepts. However, there is a question about whether teaching and learning mathematics at the school level emphasizes the axiomatics of mathematics to help students construct their mathematics from the basics to advanced levels. This paper focuses on axiomatic thinking as a basis for establishing the epistemic structure of mathematics from the basic to advanced constructions with cases and examples. The epistemic and pedagogical implications of axiomatic thinking in school mathematics will be discussed.

SP2: **Gianni Dal Maso**, Scuola Internazionale Superiore di Studi Avanzati (SISSA), Italy

Title: **Homogenisation of free discontinuity problems**

Email: dalmaso@sissa.it

Abstract: We study deterministic and stochastic homogenisation problems for free discontinuity functionals under hypotheses which lead to an interaction between surface and volume energies. The results are based on a compactness theorem with respect to Gamma-convergence, on the characterisation of the integrands of the Gamma-limit by means of limits of minimum values of some auxiliary minimum problems on small cubes, and on the subadditive ergodic theorem for the stochastic part.

SP3: **Mukesh Dhamala**, Georgia State University, Atlanta, USA

Title: **Brain network flow dynamics in human epilepsy**

Email: mdhamala@gsu.edu

Abstract: Oscillatory interactions and synchrony in neuronal electrical activity are essential for normal brain function. Disruptions to these network interactions and synchrony can be indicative of neurological disorders, including epilepsy. In recent years, research has focused on using analysis of experimental brain activity recordings and the concept of synchrony in nonlinear coupled oscillators to develop potentially lifesaving treatments for epilepsy patients. This lecture will explore these approaches and recent results in using network flow dynamics to track seizures and aid in the treatment of medication-resistant epilepsy patients. The speaker will discuss the potential benefits and limitations of these techniques and their impact in the field. Overall, this talk aims to provide an overview of the current state of quantitative research in this active and rapidly evolving field.

SP4: **Zhaosheng Feng**, University of Texas Rio Grande Valley, USA

Title: **Darboux polynomials of nonlinear differential equations**

Email: zhaosheng.feng@utrgv.edu

Abstract: In this talk, we propose a systematic approach to find the first integrals and Darboux polynomials of nonlinear differential systems. As applications, some new Darboux polynomials of

nonlinear systems arising in physics, biology, neural networks, and fluid mechanics are investigated and found. Particularly, a nonintegrable three-dimensional system with non-chaotic behaviors is introduced and traveling wave solutions are presented and classified.

SP5: **Debasis Kundu**, Indian Institute of Technology Kanpur, India

Title: **Bivariate Distributions with Singular Components**

Email: kundu@iitk.ac.in

Abstract: In this talk we mainly discuss classes of bivariate distributions with singular components. It is observed that there are mainly two different ways of defining bivariate distributions with singular components, when the marginals are absolutely continuous. Most of the bivariate distributions available in the literature can be obtained from these two general classes. A connection between the two approaches can be established based on their copulas. It is observed that under certain restrictions both these classes have the same copulas. Several properties can be established of these proposed classes. It is observed that the maximum likelihood estimators may not always exist, whenever they exist they can be obtained very efficiently by using EM algorithm. Bayesian inference of the unknown parameters also can be established based on a very flexible set of priors. We provide multivariate generalizations of both the methods. We propose several open problems and finally conclude the paper.

SP6: **Jinkai Li**, South China Normal University, Guangzhou, China

Title: **Dynamic behavior of entropy of the compressible Navier-Stokes equations**

Email: jklimath@m.scnu.edu.cn

Abstract: In the presence of vacuum, the physical entropy for polytropic gases behave singularly and it is thus hard to study its dynamics. In this talk, we present some recent studies on the dynamic behavior of the entropy to the viscous compressible ideal gases in the presence of vacuum either at the far field or on the gas-vacuum interface. It will be shown in this talk that, in the case that the vacuum presents at the far fields only, the uniform boundedness of the entropy can be propagated locally or globally if the initial density decays slowly, while if the initial density decays sufficiently fast, the entropy becomes unbounded immediately after the initial time, in particular, the entropy tends to infinity at the far field.

SP7: **Ian McKeague**, Columbia University, New York, USA

Title: **Concurrent functional linear regression with application to wearable device data**

Email: m2131@columbia.edu

Abstract: This talk discusses a nonparametric inference framework for occupation time curves derived from wearable device data. Such curves provide the total time a subject maintains activity above a given level as a function of that level. Taking advantage of the monotonicity properties of these curves, we develop a likelihood ratio approach to construct confidence bands for mean occupation time curves. An extension to fitting concurrent functional regression models is also developed. Application to wearable device data from an ongoing study of an experimental gene therapy for mitochondrial DNA depletion syndrome will be discussed. Based on joint work with Hsin-Wen Chang (Academia Sinica).

SP8: **Christian Schmeiser**, University of Vienna, Vienna, Austria

Title: **Monk's sailboat, friction from dynamic chemical adhesions, and rolling leukocytes**

Email: christian.schmeiser@univie.ac.at

Abstract: Many types of moving biological cells produce friction relative to their environment by the action of dynamic chemical adhesions. A class of mathematical models for the binding and unbinding of chemical adhesions in the form of a Volterra integral equations will be presented. In the limit of fast binding and unbinding, friction models are derived, including various forms of nonlinear friction. Some rigorous results on these limits will be presented as well as an application to the rolling of leukocytes along the walls of arterial blood vessels. (joint work with V. Milisic and D. Oelz)

SP9: **Elissa Schwartz**, Washington State University, Pullman, USA

Title: **Mathematical model of mutation in Equine Infectious Anemia Virus infection suggests a path to viral clearance with repeated vaccination**

Coauthors: Christian Costris-Vas, and Stacey Smith?

Email: ejs@wsu.edu

Abstract: Equine infectious anemia virus (EIAV) is a lentivirus similar to HIV that infects horses. Clinical and experimental studies demonstrating immune control of EIAV infection hold promise for efforts to produce an HIV vaccine. Antibody infusions have been shown to block both wild-type and mutant virus infection, but the mutant sometimes escapes. Using these data, we develop a mathematical model that describes the interactions between antibodies and both wild-type and mutant virus populations, in the context of continual virus mutation. The aim of this work is to determine whether repeated vaccinations through antibody infusions can reduce both the wild-type and mutant strains of the virus below one viral particle, and if so, to examine the vaccination period and number of infusions that ensure eradication. The antibody infusions are modeled using impulsive differential equations, a technique that offers insight into repeated vaccination by approximating the time-to-peak by an instantaneous change. We use impulsive theory to determine the maximal vaccination intervals that would be required to reduce the wild-type and mutant virus levels below one particle per horse. We show that seven boosts of the antibody vaccine are sufficient to eradicate both the wild-type and the mutant strains. In the case of a mutant virus infection that is given infusions of antibodies targeting wild-type virus (i.e., simulation of a heterologous infection), seven infusions were likewise sufficient to eradicate infection, based upon the data set. However, if the period between infusions was sufficiently increased, both the wild-type and mutant virus would eventually persist in the form of a periodic orbit. These results suggest a route forward to design antibody-based vaccine strategies to control viruses subject to mutant escape.

SP10: **Adnan Sljoka**, RIKEN Center for Advanced Intelligence Project (AIP), Japan

Title: **Probing Protein Function and Biological secrets with Rigidity Theory, Simulations and AI**

Email: adnanslj@gmail.com

Abstract: Proteins are essential macromolecules that perform vital biological functions and are frequent targets for drug development. Accurately determining their atomic level 3D structures, predicting their flexibility and dynamics, and understanding their allosteric coupling is crucial for comprehending protein function. Allostery is a poorly understood mechanism of regulation, also referred to as the "second secret of life," which involves the modulation of activity at a topographically distinct site on the protein from its active site. We have made significant advances in mathematical

rigidity theory (a blend of computational geometry, graph theory and combinatorics), for fast computational predictions of protein flexibility and dynamics. We have developed novel theory and algorithms to predict allosteric communication via molecular graph rigidity transmission, which was validated experimentally through Nuclear Magnetic Resonance (NMR), mutation studies, and other biophysical experiments. Applications of these methods bring several major breakthroughs, where we illuminate the role of allostery in enzyme catalysis, activation of critical receptors and most common drug targets GPCRs and protein-DNA interactions, as reported in journals Science (2017), Nature Communications (2018), Journal of the American Chemical Society (2019), Cell (2021), Journal of Chemical Biology (2023) and Nature Structural Biology (2023). Furthermore, by combining rigidity theory with NMR data, we have developed ANSURR, a method that solves a 40-year-old open problem for measuring the accuracy of protein structures solved by NMR (Nature Communications 2020, Cell Reports 2021). Lastly, we highlight our progress in rigidity-theory-inspired Monte Carlo simulations and reinforcement learning to probe dynamics of intrinsically disordered proteins.

Differential Equations and Nonlinear Analysis (DE)

DE1: **Dhruba Adhikari**, Kennesaw State University, Marietta, USA

Title: **Solvability of Inclusions Involving Perturbations of Positively Homogeneous Maximal Monotone Operators**

Email: dadhikar@kennesaw.edu

Coauthors: Ashok Aryal, Ghanshyam Bhatt, Ishwari Kunwar, Rajan Puri, Min Ranabhat

Abstract: Let X be a real reflexive Banach space with X^* its dual space. Let $L : X \supset D(L) \to X^*$ be a densely defined linear maximal monotone operator, $A : X \supset D(A) \to 2^{X^*}$ be a maximal monotone and positively homogeneous operator of degree $\gamma > 0$, $C : X \supset D(C) \to X^*$ be a bounded demicontinuous operator of type (S_+) w.r.t. $D(L)$, and $Q : \overline{G}_1 \to 2^{X^*}$ be a compact and upper-semicontinuous operator whose values are closed and convex sets in X^*. In the case $L = 0$, we establish the existence of nonzero solutions of $Ax + Cx + Qx \ni 0$ in the set $G_1 \setminus G_2$, where G_1 and G_2 are open subsets of X such that $\overline{G}_2 \subset G_1$, $0 \in G_2$, and G_1 is bounded. Otherwise, we assume that A is bounded and establish the existence of nonzero solutions of $Lx + Ax + Cx \ni 0$ in the set $G_1 \setminus G_2$ as above. We completely remove the restrictions $\gamma \in (0, 1]$ for $Ax + Cx + Qx \ni 0$ and $\gamma = 1$ for $Lx + Ax + Cx \ni 0$ from existing results. Applications to elliptic and parabolic partial differential inclusions in general divergence form that include the p-Laplacian with $1 < p < \infty$ and satisfy Dirichlet boundary conditions are also presented.

DE2: **Ashok Aryal**, Minnesota State University Moorhead, Moorhead, USA

Title: **Initial temperature recovery via bounded linear time sampling**

Email: ashok.aryal@mnstate.edu

Coauthors: Ramesh Karki

Abstract: We have studied an inverse type problem of recovering the initial temperature profile at a desired accuracy rate from known temperature measurements at a fixed body location and suitably selected finitely many later times. In this talk, we will discuss how we have constructed a linearly growing finitely many future times in a bounded interval and how we have approximated the initial temperature profile from a finite time observation taken at a fixed point of a thin, uniform one-dimensional rod with the desired accuracy, provided the initial temperature is in a suitable closed L^2-subspace.

DE3: **Hynek Baran**, Silesian University in Opava, Opava, Czech Republic

Title: **Jets: Computing symmetries and conservation laws of partial differential equations with a help of computer algebra.**

Email: hynek.baran@math.slu.cz

Abstract: Jets is a set of Maple procedures to facilitate solution of differential equations in total derivatives on diffieties. Otherwise said, Jets is a tool to compute symmetries, conservation laws, zero-curvature representations, recursion operators, any many other invariants of systems of partial differential equations.

DE4: **Rajendra Dahal**, Coastal Carolina University, Conway, USA

Title: **Monotonicity and Convexity Results for Discrete Fractional difference Operators**

Email: rdahal@coastal.edu

Abstract: We will introduce discrete fractional calculus from its basics, its developments over the years with some recent results in the field of monotonicity and convexity. We also show, mostly by

means of numerical simulation, that it is possible to deduce information about the monotonicity of a function f in spite of the non-positivity of the discrete forward difference of the function f.

DE5: **Bekha Ratna Dangol**, Department of Mathematics, Patan Multiple Campus, Tribhuvan University, Lalitpur, Nepal

Email: bekha.dangol@pmc.edu.np

Title: **Dispersive Effects on General Two-Phase Mass Flow Model**

Coauthors: Chet Nath Tiwari, Parameshwari Kattel, Jeevan Kafle

Abstract: A series of impulsive waves are produced by the sudden displacement of water in rivers, lakes, reservoirs, and oceans due to the impacts of earthquakes, landslides, and volcanic eruptions. Tsunamis from most landslides and moderate earthquakes tend to display dispersive behavior in some directions. Modelling of such water waves (tsunamis) are classically based on single-phase Boussinesq-type wave models, two-phase models based on hydrostatic, depth-averaged balance equations. To study the mass flow with dynamic interaction between the phases with dispersive effects, we include non-zero vertical acceleration in existing mass flow model. The enhanced two-phase non-hydrostatic model for solid grains and viscous fluid includes fundamentally dominant physical aspects such as buoyancy, drag, virtual mass, Newtonian and Non-Newtonian viscous effects. So, this contribution presents a foundation for a numerical simulation of mass flows where the non-hydrostatic and dispersive waves are more pronounced. Such modellings and numerical experiments can adequately describe the complex dynamics of water waves with frequency dispersion, submarine mass movements and associated phenomena and are applicable to mitigate the hazards caused by tsunamis and submarine sediment transport.

DE6: **Jhavi Lal Ghimire**, Central Department of Mathematics, Tribhuvan University, Kathmandu, Nepal

Title: **Some I-Convergent Sequence Spaces Defined by Orlicz Function in 2- Normed Space**

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Coauthors: Narayan Prasad Pahari

Abstract: In functional analysis and related subject matter of mathematics, a sequence space is a special case of function space if the domain is restricted to the set of natural numbers. It is a vector space whose elements are infinite sequences of real or complex numbers. Equivalently, the set ω of all functions from the set of natural numbers N to the field K of real or complex numbers can be turned into a vector space. A sequence space is defined as a linear subspace of ω. Let l_∞, c_0 and c be the linear spaces of bounded, null and convergent sequences with complex terms respectively and the norm in these spaces is given by $||x|| = \sup_k |x_k|,\ k \in N$.
Recently, a bulk number of research works have been done in the area of sequence spaces. In this presentation, we shall discuss the sequence spaces of types I-convergent, I-null, bounded I-convergent and bounded I-null, denoted by $C^I(M, \|.,.\|)$, $C_0^I(M, \|.,.\|)$, $m^I(M, \|.,.\|)$ and $m_0^I(M, \|.,.\|)$ respectively, defined by Orlicz function in $2-$ normed space. In fact, it is the successive natural generalizations of well-known sequence spaces c_0 and c, l_∞ . Moreover, we shall explore some of linear topological structures of these spaces when topologized it with suitable natural norm.

Keywords: Orlicz function, Orlicz sequence space, Ideal convergence, Normal space, Sequence algebra

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DE7: **Karel Hasík**, Silesian University in Opava, Opava, Czech Republic

Title: **Two reasons for the appearance of pushed wavefronts in the Belousov-Zhabotinsky system with spatiotemporal interaction**

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Coauthors: Jana Kopfová, Petra Nábělková, Olena Trofymchuk, and Sergei Trofimchuk

Abstract: We prove the existence minimal speed of propagation $c_*(r, b, K) \in [2\sqrt{1-r}, 2]$ for wavefronts in the Belousov-Zhabotinsky system with a spatiotemporal interaction defined by the convolution with (possibly, "fat-tailed") kernel K. The model is assumed to be monostable non-degenerate, i.e. $r \in (0, 1)$. The slowest wavefront is termed pushed or non-linearly determined if its velocity $c_*(r, b, K) > 2\sqrt{1-r}$. We show that $c_*(r, b, K)$ is close to 2 if i) positive system's parameter b is sufficiently large or ii) if K is spatially asymmetric to one side (e.g. to the left: in such a case, the influence of the right side concentration of the bromide ion on the dynamics is more significant than the influence of the left side). Consequently, this reveals two reasons for the appearance of pushed wavefronts in the Belousov-Zhabotinsky reaction

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DE8: **Xianpeng Hu**, City University of Hong Kong, Kowloon, Hong Kong

Title: **Defects in Liquid Crystal Flows**

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Abstract: In this talk, we consider the dynamical properties of topological defects in 2D flows of liquid crystals modeled by the Ginzburg-Landau approximations. In order to overcome the potential irregularity of fluid velocity fields, the fluid is transported by a nonlocal (an averaged) velocity and is coupled with effects of the elastic stress. We applied the local energy inequality to establish identities for motion of both first and second moment associated with the energy density. It is verified that the defects move along the trajectories of the flow associated with this averaged velocity, that is

$$\frac{d}{dt}a_j(t) = \mathbf{u}(a_j(t), t).$$

DE9: **Anju Kafle**, Central Department of Mathematics, Tribhuvan University, Kathmandu, Nepal

Title: **Numerical Solution of a Schrödinger Equation By Crank-Nicolson Scheme**

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Coauthors: Jeevan Kafle

Abstract: The Schrödinger Equation is a fundamental equation in quantum mechanics that describes how wave functions evolve over time. The study explored various finite difference methods for solving the equation, with a specific focus on the Crank-Nicolson scheme, which is widely used and efficient method. By applying these methods to the one-dimensional Schrodinger equation, the work provided insights into the behavior of these systems. To confirm the accuracy and reliability of this method, several test problems are solved. These tests demonstrate that the method is effective for solving the Schrödinger equation, even when an analytical solution is not possible or too difficult to obtain. In addition to examining the Schrödinger Equation, the work also delved into the concept of tunneling in three regions. Overall, the Crank-Nicolson difference scheme is a valuable tool for understanding the behavior of quantum systems and solving problems.

DE10: **Kalaivani Kamalakkannan**, Vellore Institute of Technology, Vellore, India

Title: **Generalized Hausdorff operators between weighted spaces**

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Abstract: The talk mainly concerned about the characterization for boundedness of the generalized Hausdorff operator on weighted spaces of integrable functions. As corollaries, the description of the generalized Hausdorff operator on $L_1(w)$ is presented for different cases of weight functions. Finally, we concluded with the range of the operator.

DE11: **Ramesh Karki**, Indiana University East, Richmond, USA

Title: **Recovery of an initial temperature of a one-dimensional body from finite time-observations**

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Coauthors: Chava Shawn, Young You

Abstract: We have studied an inverse problem of recovering an initial temperature profile of a thin uniform one-dimensional rod of finite length from finite time observations made at a suitably chosen fixed location of the rod and specifically selected finitely many time instances. Here we have expanded the outcome of an inverse problem studied by Aryal and Karki (2022) under the Dirichlet boundary setting to the Neumann boundary setting.

DE12: **Eduard Kirr**, University of Illinois, Urbana-Champaign, USA

Title: **Can one find all coherent structures supported by a nonlinear wave equation?**

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Abstract: I will present a new mathematical technique aimed at discovering all coherent structures supported by a given nonlinear wave equation. It relies on global bifurcation analysis which shows that, inside the Fredholm domain, the coherent structures organize themselves in in manifolds which either form closed surfaces or must reach the boundary of this domain. I will show how one can find all the limit points at the Fredholm boundary for the particular case of Nonlinear Schrödinger/Gross-Pitaevskii Equation and use these limit points to find all coherent structures and their bifurcation points.

DE13: **Akshay Kumar**, University of Hyderabad, Hyderabad, India

Title: **Riemann problems for isentropic equation of gas dynamics**

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Coauthors: Repaka Radha

Abstract: In this paper, a few class of exact solutions are obtained using the differential constraint method for isentropic gas dynamics equations. Two Riemann problems, one with constant initial data and the second one for non constant initial data is presented with a complete characterization of the solutions through shock waves and/or rarefaction waves. Moreover, solution obtained for generalized Riemann problem using series expansion is an approximation to our exact solution.

DE14: **Ramesh Kumar**, Vellore Institute of Technology, Vellore, India

Title: **Existence of common fixed point theorems under w-distance with applications to nonlinear integral equations and fractional differential equation**

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Abstract: Some new common fixed point results under the generalized contraction condition using w-distance and weak altering distance functions are proved. Also, the validity of the results is demonstrated by an example along with a numerical experiment for approximating the common

fixed point. Later, as applications, the unique common solutions for the system of nonlinear Fredholm integral equations, nonlinear Volterra integral equations and nonlinear fractional differential equations of Caputo type are derived.

DE15: **Supriya Mondal**, National Institute of Technology Durgapur, Durgapur, India

Title: **Lie symmetries, optimal system and exact solutions of a nonlinear elastic rod equation**

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Coauthors: Sarit Maitra

Abstract: The world surrounding us is intrinsically nonlinear. In this regard, nonlinear partial differential equations are of substantial significance in describing complicated physical phenomena; for instance, nonlinear wave propagation in elasticity theory, fluid dynamics, plasma physics, nonlinear optics, etc. In this study, we have considered a fourth-order nonlinear partial differential equation that describes the propagation of longitudinal waves through a nonlinear elastic rod with lateral inertia. In order to determine the invariant solutions and similarity reductions for the nonlinear elastic rod equation, we obtain Lie infinitesimal generators, possible vector fields, and their commutative and adjoint relations by performing the Lie symmetry analysis. Accordingly, the invariants of the Lie algebra and one-dimensional optimal system of subalgebras are determined with the help of commutative and adjoint relations. Based on the optimal system, Lie symmetry reductions of the nonlinear elastic rod equation are derived, and numerical solutions of these equations are presented for different values of the model parameters within a realistic range, resulting in parabolic-type solutions each time. Furthermore, using the first integral method, we have determined two new exact solutions of the nonlinear elastic rod equation. These findings make this work unique.

DE16: **Vivek Natarajan**, Indian Institute of Technology Bombay, Mumbai, India

Title: **Nonsmooth feedback control of infinite-dimensional systems**

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Coauthors: Bhagyashri Gurjar

Abstract: Consider the following linear control system evolving on a Hilbert space X:

$$\dot{x}(t) = Ax(t) + B[u(t) + d(t)], \qquad y(t) = Cx(t).$$

Here $x(t) \in X$ is the state, $u(t) \in \mathbb{R}^m$ is the control input, $d(t) \in \mathbb{R}^m$ is the unknown disturbance, $y(t) \in \mathbb{R}^p$ is the measured output, A is the generator of a strongly continuous semigroup on X, $B : \mathbb{R}^m \mapsto X$ is the control operator and $C : X \mapsto \mathbb{R}^p$ is the observation operator. The control problem is to find maps f and g such that the input u generated by the dynamic output feedback controller

$$\dot{x}_c(t) = f(x_c(t), y(t)), \qquad u(t) = g(x_c(t), y(t))$$

ensures that the state trajectories of the above linear control system converge to zero asymptotically for any disturbance d and initial state $x(0) \in X$. When X is finite-dimensional, under certain boundedness assumptions on the disturbance, several works have addressed this problem using nonsmooth nonlinear functions f and g. In contrast, few works have studied this problem when X is infinite-dimensional. In this talk, we will first discuss the developments and major contributions over the past decade to this problem when X is infinite-dimensional, and also highlight the associated challenges. We will then describe our recent contribution which involves using a disturbance observer based on super-twisting sliding mode algorithm to estimate the disturbance and then cancelling the disturbance directly from the above linear control system using the estimate.

DE17: **Jayadev Nath**, Central Department of Mathematics, Tribhuvan University Kathmandu, Nepal

Title: A_p **Weights and Some Weighted Inequalities**

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Abstract: A_p weights play a crucial role in the theory of singular integrals, which often have important applications in areas such as partial differential equations, harmonic analysis, and signal processing. In this presentation, we will explore various properties of A_p weights and discuss some weighted inequalities.

DE18: **Hem Raj Pandey**, Pokhara University, Pokhara, Nepal

Title: **Fractional-Order Derivative Model of Dengue Disease with Vaccination**

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Coauthors: Ganga Ram Phaijoo, Dil Bahadur Gurung

Abstract: Dengue is a vector-borne disease that is rapidly spreading around the world. It is one of Nepal's emerging public health issues. Dengue cases have been reported in Nepal's tropical and subtropical regions since 2004. The Caputo fractional-order derivative SVEIRP-SEI epidemic model with vaccination is used in the present work to investigate the transmission of dengue infection phenomena. The next generation matrix is used to calculate the basic reproduction number R_0. The mathematical and simulation results show that vaccination is one of the most effective strategies for significantly lowering disease prevalence.

DE19: **Shankar Pariyar**, Central Department of Mathematics, Tribhuvan University Kathmandu, Nepal

Title: **Numerical Analysis for Fractional Calculus**

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Coauthors: Jeevan Kafle

Abstract: The original concept underlying fractional calculus is heavily utilized in many different scientific fields. There haven't been many studies on the numerical and analytical aspects of any order of fractional derivatives and integration. In this work, we compare several approximate solutions of the fractional equation with the approximate solutions of the non-fractional equation when $\alpha = 1$ when $\alpha = 0$ to 1, systemic diagrams in two or three dimensions are typically found. The behavior of the identity, sine, and cosine functions in specific situations is examined in the context of Caputo Fabrizio's fractional differentiation equation (FDE). Using the Grunewald-Letinikov (G-L) numerical solution, non-zero fractional derivatives of a constant function are avoided in this work. Using quadratic interpolation, we derive a numerical approximation to the Caputo-Fabrizio derivative known as the L1-2 formula. Lagrange interpolation is used to obtain quadratic and cubic convergence rates for the L1 and L1-2 formulas, respectively. We compute the theoretical and numerical Caputo-Fabrizio derivatives of a few well-known functions. The convergence rates seen in theory are supported by numerical evidence.

DE20: **Bhupendra Paudyal**, Central State University, Wilberforce, USA

Title: **Invariant subspaces of composition operators on $\mathcal{S}^2$**

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Abstract: Suppose φ is an analytic self-map of the unit disk $\mathcal{D}$ and $\mathcal{S}^2$ is the space of the holomorphic functions such that their first derivative belong the Hardy space $\mathcal{H}^2$. The composition operator C_φ on $\mathcal{S}^2$ are defined by $C_\varphi(f) = f \circ \varphi$. In this work, we study the shift-invariant subspaces that are invariant for composition operators.

DE21: **Eeshwar Prasad Poudel** , Central Department of Mathematics, Tribhuvan University, Nepal

Title: **Mathematical Modelling of Dispersion of air pollutants: Optimal Measure and Control**

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Coauthors: Jeevan Kafle, Shree Ram Khadka

Abstract: Air pollution is a mixture of harmful solid, gases and other pollutants in air. Air pollution cause long-term damage to people's nerves, brain, kidneys, liver, and other organs. Some scientists suspect air pollutants cause birth defects. So, to make the lives of almost all of the things, i.e., both living and non-living better, mitigation of air pollution is essential. In this work, a model for pollution is planning to develop which includes frequency dispersion and turbulent effect which can better describe pollution dispersion, optimal measure, and control of air pollution. Additionally, the pollution equation for advection and diffusion will also develop to analyze the pollutants concentration. The model illustrates that there is fundamentally different simulation results by observing by variation of model parameters. The validation of the expected model will be accomplished using parameter analyses through available laboratory and field data. The possible hazard mitigation measures will be analyzed and suggested differently. The insights of this work will directly contribute to environmental sustainability by mitigating pollutants concentration, especially in the core urban areas. Additionally, the work is also applicable for optimal measurement techniques and way forward for controlling the pollution level in the atmosphere.

Keywords: Air Pollution, Dispersion, Turbulent effect, Optimal Measure

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DE22: **Madhav Prasad Poudel**, Pokhara University, Pokhara, Nepal

Title: **Kummer's Theorems, Popular Solutions and Connecting Formulas on Hypergeometric Function**

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Coauthors: Harsh Vardhan Harsa, Narayan Prasad Pahari, Dinesh Panthi

Abstract: The Hypergeometric series is the extension of the geometric series. The Confluent Hypergeometric Function is the solution of the Hypergeometric Differential Equation $[\theta(\theta + b - 1) - z(\theta + a)] = 0$ Kummer's first formula, Kummer's second formula are of significant importance in solving the differential equations. Kummer has developed six solutions for the differential equation and twenty connecting formulas. The connecting formula consist of a solution expressed as the combination of two other solutions. This research work has extended the connecting formulas obtained by Kummer to obtain the other six solutions $w_1(z), w_2(z), w_3(z), w_4(z), w_5(z)$ and $w_6(z)$ as the combination of three solutions obtained by Kummer.

DE23: **Raj Kumar Pradhan**, Kathmandu University, Dhulikhel, Nepal

Title: **Traffic dynamics of vehicles-pedestrians interaction at non-signalized intersections and its impact on fuel consumption and gas emission**

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Coauthors: Samir Shrestha, Dil Bahadur Gurung

Abstract: Currently, the volume of traffic on the roads is increasing quickly in developing countries. The well-being of civilizations suffers as a result of the growing amount of traffic on roads. In most nations and cities, traffic is growing, and the rising need for transportation has been pointed as one of the biggest problems. High levels of traffic demand can have adverse effects such as congestion, delayed travel times, increased energy use, and pollution. In this paper, the traffic dynamics of vehicles and pedestrians at the non-signalized intersection are carried out. The vehicles follow the car-following models using the optimal velocity function in a single lane. On the other hand, the non-interacting pedestrians arrive at the curbside of the road following the Poisson distribution and cross the road. The interaction between vehicles and pedestrians at the intersection is studied

to estimate the vehicle delay time, amount of fuel consumption, and emission of CO2, NOx, HC, and CO. The dynamics of vehicles and pedestrians are modeled by a set of ordinary differential equations and numerical simulations are performed to analyze the studies.

Keywords: Traffic dynamics, optimal velocity, interaction, vehicle delay time, fuel consumption

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DE24: **Min Ranabhat**, University of Delaware, Newark, USA

Title: **First Order Inequalities associated to Convex Functions**

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Abstract: Under various assumptions on the Monge-Ampere measure, μ_ϕ, associated to a convex function ϕ we will present a series of first order inequalities in the Monge-Ampere quasi-metric structure shaped by the convex function ϕ for the Monge Ampere gradient ∇^ϕ.

DE25: **Pawan Shrestha**, Tribhuvan University, Kathmandu, Nepal

Title: **Regularity of 2D Surface Quasi Geostrophic (SQG) Equations an Its Numerical Simulations**

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Coauthors: Durga Jang KC, Ramjee Sharma

Abstract: In this presentation, we present some results on the numerical solutions of the 2-D Surface Quasi Geostrophic Equation (SQG) using the pseudospectral method along with an exponential filter. The global regularity of the solution of the inviscid SQG equation for general data remains an outstanding open problem. We mainly focus on the inviscid and supercritical cases and monitored the regions where the level curves come significantly close to one another, the L^2 norm, and the growth of $|\nabla^\perp\theta|$ throughout our computations. Our numerical findings show that there is no significant difference among the solutions of the supercritical, critical, and subcritical cases as we vary the values of the parameter α in the interval $(0, 1)$.

DE26: **Bishnu Hari Subedi**, Tribhuvan University, Kathmandu, Nepal

Title: **Some Attempt of Proving Eremenko's Conjecture in Holomorphic Semigroup Dynamics**

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Abstract: In classical transcendental dynamics, Eremenko's conjecture is considered an outstanding open problem, and it has many partial solutions. This conjecture has been proved for a general transcendental entire function for the fast escaping set, which consists of points that tend to infinity as fast as possible under iteration. In holomorphic semigroup settings, we have investigated general-type partial solutions. We expect that for a general transcendental semigroup, Eremenko's conjecture may be solved with a strong solution. In this research, we made some further attempts to proving Eremenko's conjecture.

DE27: **Anurag Shukla**, Rajkiya Engineering College Kannauj, Kannauj, India

Title: **Optimal Control for Nonlinear Differential Equations**

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Abstract: Optimal Control is one of the fundamental concepts in mathematical control theory and is widely used in many fields of science and technology. In this talk, a systematic study of optimality for finite dimensional and infinite dimensional differential equations is discussed with the help of the basics of matrix theory, calculus of variation, and functional analysis.

DE28: **Sundar Tamang**, Western New Mexico University, Silver City, USA

Title: **The Inverse Volatility Problem for Currency Options**

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Coauthors: Ian Knowles

Abstract: In transactions associated with future-oriented financial instruments, such as options, a huge amount of data is available buried inside of which is the market's best guess as to what the future holds. We consider here the possibility of extracting future foreign exchange volatility information from foreign exchange option data with the aid of a new computational inverse algorithm using minimization of a convex functional.

DE29: **Andrei Tarfulea**, Louisiana State University, Baton Rouge, USA

Title: **Applications of Mass Spreading to Regularity for the Boltzmann Equation**

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Coauthors: Christopher Henderson, Stanley Snelson Abstract: The Boltzmann equation models a high-energy gas with elastic collisions. From the mathematical point of view, it presents a nonlocal degenerate-parabolic PDE with very few coercive quantities. The existence of global smooth solutions remains an open problem, and the state of the art is summarized by the conditional regularity program: as long as the hydrodynamic quantities (mass, energy, and entropy densities) remain "under control" (satisfying four time-independent inequalities), the solution is in fact smooth. We eliminate two of the four inequalities from the conditional regularity result by showing that solutions of the Boltzmann equation dynamically (and instantly) fill any vacuum regions; the estimates only depend on an initial (possibly small) core of mass. We then examine how this mass spreading effect enhances known results on the construction, regularity estimates, uniqueness, and continuation for solutions starting from very rough initial data.

DE30: **Ramesh Chandra Timsina**, Tribhuvan University, Nepal

Title: **Richards Equation for assessment of Landslide Hazards**

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Coauthors: Kedar Nath Uprety, Harihar Khanal

Abstract: To study the landslide hazards induced by heavy rain fall, infiltration and redistribution, the solution of axi symmetrical 2D Richards equation with recharge and evapotranspiration is used. Since Richards equation is highly non-linear, its analytical solution are rare and irrelevant. We linearize the equation applying Kirchhoff integral transform and discretize the equation with different time stepping schemes. Generally, the landslide hazard problem is governed by safety factor related to the forces that prevent the slope from falling and enabling the slope to collapse. To evaluate the safety factor we use the Infinite Slope Model characterized with moisture content, pressure head in variably saturated (unsaturated) soils which are directly related to the solution of the Richards equation.

Keywords: Richards equation, Moisture content, Kirchhoff transformation, Landslide hazards, Safety factor.

DE31: **Chet Nath Tiwari**, Tri-Chandra Multiple Campus, Tribhuvan University, Kathmandu, Nepal

Title: **A Two-Phase Model for a Debris Flow/Flood down a Meandering Conduit**

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Coauthor: Bekha Ratna Dangol, Jeevan Kafle, and Parameshwari Kattel

Abstract: Natural debris flow/floods pass through straight and meandering channels. Classical studies on the mathematical models of gravity-driven debris flows/floods down in natural and

generic topography are primarily concentrated on single-phase, mixture, two layers, and two-phase solid and viscous fluid. The flow behaviour is greatly influenced by the concentration of solid, fluid, and their interactions along with the channel geometry. In particular, these flows in meandering conduits, the dynamics and evolution of the phases are controlled by the centrifugal-force-induced stratification and pressure gradient created by the force acting on the fluid. Here, we present an enhanced two-phase numerical model for the simulation of the flow dynamics and mass transport in the meandering channels with different sinuosities and amplitudes as in the natural meandering rivers. The model is based on depth-averaged continuity and momentum conservation equations that includes the essential physical aspects such as buoyancy, drag, virtual mass, and Newtonian and Non-Newtonian viscous effects. So, this contribution presents a foundation for the numerical experiments to better understand the dynamics of debris flows/floods down meandering channels as seen in the natural paths of the rivers as well as already existing channels like episodic rivers in hilly regions. The results can be extended to propose some appropriate mitigation strategies

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DE32: **Pitamber Tiwari**, Central Department of Mathematics, Tribhuvan University, Kathmandu, Nepal

Title: **Quantum estimates of Hermite-Hadamard integral inequality on products of extended geometric convex functions**

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Coauthors: Chet Raj Bhatta

Abstract: The integral mean of a convex function is connected to the Hermite-Hadamard inequality. Pachpatte established the results on the products of two classical convex functions. In this paper, some new results on the products of generalized geometric convex functions have been obtained, and these results are further extended to q-analogs which is a new paradigm in convexity theory and integral inequality.

DE33: **Anita Tomar**, Pt. L. M. S. Campus, Sridev Suman Uttarakhand University, Rishikesh, India

Title: **Some Applications of Unique and Non-Unique Fixed Points**

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Abstract: The existence of a fixed point plays a significant role in the nonlinear analysis as many real-world problems can be reformulated as a problem of finding a fixed point of nonlinear maps. Fixed point theory is the most vibrant area of research. Banach provided the primary metric fixed point result and evidenced that each contraction in a complete metric space has a unique fixed point. One of the significant outcomes of the fixed point theory is when a map under minimal suitable conditions has a unique fixed point. However, in some situations, the fixed point of a map may not be unique. Non-unique fixed points of a discontinuous self-map perform an essential role in fixed point theory. Because if the fixed point is not unique then the set of non-unique fixed points may include a circle, a disc, an ellipse an elliptic disc, or a hyperbola, and may have several applications in Biology, Neural Networks, Economics, and Artificial Intelligence. The geometry of fixed points performs a remarkable role in real-world problems. In this talk, we discuss some applications of the existence of a fixed point and fixed figures.

DE34: **Petr Vojcak**, Mathematical Institute of the Silesian University in Opava, Opava, Czech Republic

Title: **Non-Abelian covering and new recursion operators for the 4D Martínez Alonso-Shabat equation**

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Abstract: We present new recursion operators for (shadows of nonlocal) symmetries of the 4D Martínez Alonso - Shabat equation (shortly 4D MAS equation)

$$u_{ty} = u_z u_{xy} - u_y u_{xz}, \tag{1}$$

and we show that their actions can produce new symmetries which are not contained in the Lie algebra of nonlocal symmetries presented in KrasVoj. To this end, we construct a non-Abelian covering of the equation in question using the Lax pair with two non-removable parameters.

An extremely interesting feature of the newly presented recursion operators for the 4D MAS equation (1) is their explicit dependence on independent variables. This generally seems to be a very unusual property among the known today recursion operators for equations in more than two independent variables, especially in the situation when the equations do not depend explicitly on the independent variables.

Mathematical Biology (MB)

MB1: **Khagendra Adhikari**, Tribhuvan University, Kathmandu, Nepal

Title: **Transmission Dynamics of COVID-19 in Nepal: Mathematical Models for Effective Control**

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Coauthors: Ramesh Gautam, Anjana Pokharel, Kedar Nath Uprety, Naveen K. Vaidya

Abstract: The COVID-19 pandemic has posed unexpected troubles and hazard to the global health system, particularly in low- and middle-income countries like Nepal. In this talk, we will discuss some mathematical models which were used to study the transmission dynamics of COVID-19 in Nepal during the first and second wave. With the help of mathematical models, we will also go over the effectiveness of the control measures put in place by the government of Nepal to reduce the burden of disease.

MB2: **Raghu Bhatta**, Aishwarya Multiple Campuss, Dhangadhi, Nepal

Title: **The Impact of Yoga Awareness on the Dynamics of a Time-Delayed Communicable Disease: A SIR Model Analysis**

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Abstract: This paper aims to investigate the effects of Yoga awareness on the dynamics of a communicable disease which is spreading in a population with time delay. The model considers contributions to the overall awareness from Yoga Sadhaka individuals, Yoga aware information campaign, direct contacts between unaware and aware individuals and reported cases of infection. It is assumed that there is some time delay between individuals becoming aware and modifying their behaviour. Yoga Pranayam develops an awareness in unaware individuals and it is further assumed that Yoga-induced immunity may wane with time. Time delayed SIR model with Yoga awareness is formulated and analyzed. Stability analysis of disease-free and endemic equilibrium is studied analytically. Analytical results are supported by numerical simulation of the model to illustrate the dynamic behaviour of the model.

MB3: **Gauri Bhuju**, Kathmandu University, Dhulikhel, Nepal

Title: **Bifurcation Analysis of the Fuzzy Model of Dengue Disease**

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Coauthors: Ganga Ram Phaijoo and Dil Bahadur Gurung

Abstract: Dengue is a vector-borne infectious disease that has spread nearly across the world. The cases of dengue are increasing every year. In this work, we discuss the transmission dynamics of dengue disease using the fuzzy epidemic SEIR-SEI compartmental model with the intervention of bed nets and fumigation. The bifurcation occurs when the stability of an equilibrium point of the system changes. The stability of the point is determined by fumigation, the number of people who use bed nets, and the effectiveness of bed nets. The present work describes the bifurcation points of the equilibrium with and without control measures in different virus loads. Numerical simulations are made to illustrate the mathematical result graphically.

MB4: **Pushpa Nidhi Gautum**, Central Department of Mathematics, Kathmandu, Nepal

Title: **Modeling Blood Flow Dynamics Through Artery along with Stenosis**

Coauthors: Chudamani Pokhrel, Ganga Ram Phaijoo, Parameshwari Kattel, Jeevan Kafle

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Abstract: Hemorheology is the study of blood flow in which plasma and blood cells are present. Hematocrit percentage, artery lumen, artery diameter, arterial curvature, and stenosis all have a significant impact on hemorheology. To model the blood flow, one and two-layer models, as well as single and two-phase models, are used, with different boundary conditions. The nature of blood is considered Newtonian and non-Newtonian in mathematical modeling, and flow can be considered steady as well as pulsatile. Modeling is focused to get the velocity profile, pressure drop and its ratio, volumetric flow rate, and wall shear stress in the stenosed part of the artery. The present work is to give a better understanding of the flow dynamics due to curvature, the effect of stenosis increasing over time, and two-phase blood flow. We will incorporate curvature and time-related terms and analyze their effectiveness in blood flow parameters to get an improved model. The mass and momentum balance equation will be used to explain the flow characteristics. Development of models, getting analytical solutions of the equations, and their analysis with the help of simulation is the main purpose of our study.

MB5: **Ramesh Gautam**, Ratna Rajya Campus, Kathmandu, Nepal

Title: **Modelling Malaria Transmission in Nepal: Impact of Imported Cases through Cross-Border Mobility**

Coauthors: Khagendra Adhikari, Anjana Pokharel, Kedar Nath Uprety, and Naveen K. Vaidya

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Abstract: The cross-border mobility of malaria cases poses an obstacle to malaria elimination programs in many countries, including Nepal. Here, we will present a novel mathematical model to study how the imported malaria cases through the mobility of migrants from Nepal to highly malaria-endemic countries affect the Nepal government's goal of eliminating malaria by 2026. Our model's mathematical analyses and numerical simulations, validated by malaria case data from Nepal, indicate that eliminating malaria from Nepal is possible if strategies promoting the absence of cross-border mobility, complete protection of transmission abroad, or strict border screening and isolation are implemented. For each strategy, we establish the conditions for the elimination of malaria.

MB6: **Hem Joshi**, Xavier University, Cincinnati, USA

Title: **COVID-19 Transmission and Inter-provincial Disparity in Nepal**

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Abstract: The COVID-19 pandemic started towards the end of 2019 and there are currently more that 683 million confirmed cases in 229 countries and almost seven million deaths. This disease is still a global threat and different strains emerge in different part of the world time and again. The effective controls still remain uncertain as the outcome of the pandemic varies from place to place. We studied the province-wise data from Nepal to design effective control strategies. Nepal, a landlocked country, shares an open-border with India, and thousands of Nepali migrant workers return to their home country daily, causing the virus to move with them. We also studied the inter-provincial disparities of important indicators such as movement data, epidemic trend, epidemic growth rate, and reproduction numbers. Furthermore, we extended our analysis to identify prevention and control policies that are effective in altering these indicators. In this context, we calculate the the effective reproduction number and conclude control strategies that are effective in altering the indicators vary among provinces, underscoring the need for province-focused strategies in Nepal.

MB7: **Laxman Kunwar**, Tribhuvan University, Birgunj, Nepal

Title: **Mathematical Analysis of SVIQR Epidemic Model for COVID-19 with vaccination**

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Coauthors: Vijai Shanker Verma

Abstract: In this study, we have proposed an SVIQR epidemic model for COVID-19 with vaccination. Some fundamental characteristics such as positivity of the solution, boundedness and invariance of the model are analyzed. Expressions for disease-free equilibrium (DFE) and endemic equilibrium (EE) points with certain criteria for existence are derived. Rigorous analysis of the model reveals that associated DFE is locally asymptotically stable whenever the effective reproduction number is less than one. Also, the sufficient conditions of the stability of EE point is approved. Sensitivity analysis is performed to identify key parameters that significantly affect the effective reproduction number. Analytical results are illustrated and analyzed using numerical simulation which suggests that the disease will eventually die out, particularly if the control measures are implemented above a specified level for a sustained period of time.

MB8: **Kabita Luitel**, Department of Mathematics, Bhaktapur Multiple Campus, Bhaktapur, Nepal

Title: **Effect of Clothing Thermal Transmission Parameters in the Bioheat Transfer Model**

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Abstract: Heat transfer in the human body depends on several biological, thermophysical, and environmental factors. Clothing, an interface between the human body and surroundings, plays a vital role in the human thermoregulatory system. The present paper aims to develop a mathematical model of heat transfer in the human body by adding the clothing (thermal transmission) parameters to Pennes' bioheat equation. The usual Robin boundary condition for the Pennes' model is also modified by incorporating the effective clothing factor (including clothing insulation, air insulation, and clothing area factor) and the convective heat transfer coefficient (including air velocity and the walking speed of a person). The extended bioheat equation is solved numerically using an implicit finite difference method, and the effects of clothing parameters on the temperature in the human body are investigated.

Keywords: thermal transmission parameters, thermophysical factor, thermoregulatory system, extended bioheat equation.

MB9: **Shalela Mohd Mahali**, Universiti Malaysia Terengganu, Kuala Nerus, Malaysia

Title: **A Comparison of Linear and Quadratic Growth Patterns in a Time-Dependent Drug Release Model**

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Abstract: In this research, we investigate the performance of a time-dependent drug release model with a quadratic growth pattern for the device size during swelling. This model is compared to our previous work, which used a linear growth pattern, as well as a constant and a piece-wise constant model. To test these models, we fit experimental data using the least squares fitting technique. Our preliminary results suggest that the time-dependent model with a quadratic growth pattern may outperform all other models in terms of the least squares error. Specifically, the quadratic time-dependent model produces a lower least squares error than the other models tested, including the linear time-dependent model. These findings suggest that a time-dependent drug release model with a quadratic growth pattern may provide a more accurate approach for controlled drug release applications.

MB10: **Chamila Niroshanie**, Department of Mathematics, University of Colombo, Colombo, Sri Lanka

Title: **A Study on Delayed Effect of Rainfall on Dengue Cases in Colombo District of Sri Lanka**

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Coauthors: Hasitha Erandi, Yashika Jayathunga, Kushani De Silva, and Sanjeewa Perera

Abstract: Dengue is a mosquito-borne viral disease that has widespread in many tropical and subtropical countries including Sri Lanka. Transmission of dengue is driven by various external factors and most of the factors have delayed effect on dengue cases. Rainfall is one of the major climatic factors that affect dengue transmission. In this study, we investigated the delayed effect of rainfall on dengue cases in the Colombo district of Sri Lanka using weekly rainfall data and weekly dengue cases from 2006 to 2019. The Pearson correlation coefficient has been used to identify the time delay between weekly rainfall data and weekly dengue cases. Our findings revealed a fixed 8-week lag time between rainfall and dengue cases during the study period. However, we further observed that the impact of rainfall data on dengue cases varied across different sub-intervals of the study period. In such cases of dynamic impact from rainfall, predictive models of dengue cases with fixed rainfall effect may cause uncertainties. Therefore, in this study we also investigate the impact of rainfall within specific sub-intervals to improve the dengue prediction in Colombo district.

MB11: **Kamal Panta**, Central Department of Mathematics, Tribhuvan University, Nepal

Title: **Mathematical Analysis of Hemodynamic Parameters of Blood Flow in an Artery**

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Coauthors: Jeevan Kafle, Puspa Nidhi Gautam, and Chudamani Pokharel

Abstract: In blood rheology we study volume flow rate, blood pressure, velocity, viscosity and shear stress of blood. Blood flow is a study of finding the flow rate through the blood vessel and measuring the blood pressure in the blood vessel. Cross-sectional area play an important role for smooth flow of the blood. But some other parameter like composition of blood, length of vessel also effects in the flow rate and pressure of blood. Velocity and volume flow rate is derived by using Poiseuille's equation. The main purpose of this work is to review analysis of old mathematical modeling of blood flow and blood pressure. Since blood is a non-Newtonian fluid, modeling it is particularly challenging. So here, we made the assumption that blood was a Newtonian fluid. This work presents a mathematical model of blood flow that was created using the N-S equations and computer simulation. Graphs are used to analyze the results.

MB12: **Gyan Prasad Paudel**, Graduate School of Science and Technology, Mid-West University, Nepal

Title: **Fuzzy Arithmetic–Based Algorithm for Identifying Medical Conditions**

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Coauthors: Narayan Prasad Pahari, Sanjeev Kumar

Abstract: Making the right medical decision is challenging work because, in our daily life, decision-making problems may have the components of membership and non-membership degrees with the possibility of hesitation. Since soft theory offers a theoretical framework for dealing with ambiguous, fuzzy, and ill-defined objects, it is a key development in the field of computer programming as well as other scientific disciplines. Intuitionistic fuzzy soft sets provide an effective tool for solving multiple attribute decision-making with intuitionistic fuzzy information. The most essential issue is how to derive the ranking of alternatives from the information quantified in terms of intuitional fuzzy values. This theory also has the potential to be used to solve such real-world problems. In this work, we explore how Sanchez's medical theory could be used in medical diagnosis and provide a fuzzy arithmetic-based algorithm for identifying medical conditions to address this.

MB13: **Chudamani Pokharel**, Dhawalagiri Multiple Campus, Baglung, Nepal

Title: **Analysis of the Effect of Hemodynamic Parameters of the Blood Flow through Multiple Stenosis**

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Coauthors: Pushpa Nidhi Gautam, Jeevan Kafle, Chet Raj Bhatta

Abstract: Stenosis, which typically results in hypertension, stroke, and heart attack, restricts blood flow in human arteries. Multiple stenoses are seen in blood vessels at various locations. Moreover, how repeated stenosis affects blood flow in human arteries by assuming that blood is a non-Newtonian fluid. In this work, a flow model will be constructed in an artery having multiple stenoses by incorporating the curvature effect, and turbulent effect in plasma and corpuscles of the blood. The blood flow behavior is taking different values of fluid dynamics parameters like coefficient viscosity, hematocrit, the radii, and position of multiple stenoses has been incorporated. Blood flow behaviors will be studied by taking different values of fluid dynamic parameters like viscosity, height, and position of stenosis by using an extended model. Velocity profile, volumetric flow rate, pressure drop, and shear stress will be studied in the case of single and multiple stenoses, and their findings will be analyzed. The results of the experiments showed that as hematocrit and viscosity rise, artery wall shear stress falls, indicating an increase in human heart pressure. The relationship between a rise in hemoglobin concentration and artery length is inverse. These outcomes could serve as a model in biomedical engineering for the cure of vascular-related diseases using angioplasty and have the potential to design blood-contacting devices as well as further specialize and upgrade highly sensitive diagnostics operation maneuvers like Transcatheter aortic valve implantation or balloon angioplasty.

MB14: **Saroj Pradhan**, Prairie View A & M University, Prairie View, USA

Title: **Human Respiratory Control System Model during sleep at altitude with Two Control Loops and Multiple Transport Delays**

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Abstract: We study the stability analysis of human respiratory control system during sleep at altitude. Human respiratory have two delays (peripheral control delay τ_p, and central control delay τ_b) and two negative control gains (peripheral control G_P and central control G_C). During sleep, cardiac output decreases which increases the τ_p and decreases G_P resulting increases stability. It also increases the τ_b and decreases G_C resulting decreases instability. Our conclusion is that increase in altitude increases instability. Also people who lives in high altitude have more cardiac output and have more periodic breathing during sleep than the people who lives in low altitude.

MB15: **Janta Raut**, Thakur Ram Multiple Campus, Birgunj, Nepal

Title: **Mathematical Analysis of Mucus Flow in the Lung**

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Abstract: In this paper, a two-layer planar unsteady state mathematical model is proposed to study mucus flow in human lung airways by taking into account the effects of mucus visco-elasticity and porosity due to certain immotile cilia forming porous matrix bed in the serous sub-layer in contact with the epithelium. The effect of shear stress generated by air-motion due to forced expiration and gravity at mucus-air interface is also considered in the model. . It is observed that mucus flow rate increases as the pressure drop, shear stress due to air-motion and porosity increase. It is also observed that mucus flow rate decreases as the viscosity of serous layer fluid or mucus increases, but any increase in mucus viscosity at its higher values does not seem to affect the mucus transport. Also, it is observed that mucus flow rate decreases as its modulus of elasticity increases.

MB16: **Rakesh Satyal**, Analytica Research Center, Kirtipur-9, Nayabazar, Nepal

Title: **Mathematical modeling to identify the unidentified constituents of natural products from the datafiles processed through GC-LRI-MS instrument.**

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Abstract: The identification of unknown natural product constituents is an important challenge in the field of natural product chemistry. Traditional methods of structure elucidation, such as NMR and X-ray crystallography, are often time-consuming and require large amounts of material. In recent years, there has been a growing interest in using mathematical modeling approaches to identify the constituents of natural products. This study proposes a mathematical modeling approach to identify the unidentified constituents of natural products from the data files processed through the GC-LRI-MS instrument. GC-LRI-MS is a powerful analytical technique that can generate large amounts of complex data. The proposed mathematical model is based on a combination of statistical methods and machine learning techniques, which can help to identify patterns in the data and to predict the structures of unknown constituents. The proposed mathematical model was tested on a set of natural product samples, and the results were compared to those obtained using traditional structure elucidation methods. The model was able to identify a number of unknown constituents with a high degree of accuracy, demonstrating the potential of mathematical modeling as a tool for natural product chemistry. Overall, the proposed mathematical modeling approach represents a promising tool for the identification of unknown constituents in natural products. It has the potential to greatly accelerate the process of structure elucidation and to facilitate the discovery of new natural product compounds.

MB17: **Dev Chandra Shrestha**, Kathmandu University, Dhulikhel, Nepal

Title: **FEM Approach of Metabolic Effect on Temperature Distribution in Human Dermal Parts During Walking and Marathon**

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Abstract: Conduction, convection, and radiation are the physiological processes that exchange heat energy in bi-directional routes between the body and the environment. Metabolism and evaporation are the one-way routes for the exchange of heat energy. In the metabolic process, the body creates internal heat energy and maintains the body temperature. The body loses the excess heat energy through the evaporation process and controls the body temperature. The computation has been performed for the two-dimensional Pennes' bioheat equation using a finite element approach. This study has shown steady and unsteady state temperature distribution in three skin layers, epidermis, dermis, and subcutaneous tissue, during walking and marathon. The results have demonstrated that the steady temperature of each skin layer is higher during a marathon than walking due to more metabolic effects. The computed temperature results during walking and marathon have been presented graphically.

Keywords: Metabolic Rate, Ambient Temperature, Sweat Evaporation Rate, Finite Element Method (FEM)

MB18: **Sharmila Shrestha**, Kathmandu University, Dhulikhel, Nepal

Title: **A Mathematical Study of the Effect of Sex Hormones on Temperature Distribution in Female Breast Tissue**

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Coauthors: Gokul KC, Dil Bahadur Gurung

Abstract: The female breasts are accessory organs of the reproductive system. Breast development is influenced by sex hormones (estrogen and progesterone), which the uterus releases during the

menstrual cycle. Due to the cooling effect of estrogen and the heating effect of progesterone hormones, the body core temperature, blood perfusion, and metabolism are higher in the luteal phase than the follicular phase of the menstrual cycle. An imbalance of these hormones causes a breast lump, which may be a cyst or tumor. The breast temperature is analyzed using FEM. The results show that the temperature distribution in breast tissue is higher in the luteal phase than the follicular phase. The normal breast temperature is lower than that of a tumor-embedded breast and higher than that of a cyst-embedded breast.

Keywords: Breast temperature, sex hormones, FEM.

MB19: **Rupchand Sutradhar**, Indian Institute of Technology Guwahati, Guwahati, India

Title: **Mathematical Modeling of Hepatitis B Virus Infection with Reproduced Capsids and Re-cycling Effects**

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Abstract: Hepatitis B virus (HBV) infection is a deadly liver disease throughout the world. One of the main reasons for the widespread infection is the stability of cccDNA, an intracellular component of viruses. In addition, a part of the newly produced HBV DNA-containing capsids is reused as a core particle in HBV replication. It is also investigated that the recycling of HBV capsids greatly affects the intercellular dynamics of HBV infection. In this study, a four-compartmental mathematical model is proposed incorporating the effects of recycling of HBV DNA-containing capsids to better understand the dynamics of HBV. The feasibility of the model is obtained by showing the non-negativity and boundedness of the solution. The basic reproduction number is determined and it is obtained that the present model possesses two steady states. By using the Routh-Hurwitz criteria, the local stabilities of both equilibria are established. The global stability of each steady state is shown by constructing two suitable Lyapunov functionals. The proposed model is compared with the existing models and it is observed that consideration of recycling effects of HBV DNA-containing capsids decreases the concentration of uninfected hepatocytes. Furthermore, the detailed studies on capsid to capsid production rate, the capsid-to-virus production rate, and the volume fraction of newly produced HBV capsid indicate that the accumulation of HBV capsids within the infected hepatocytes is a risk factor for HBV exacerbation. This is a key and new finding in this study.

MB20: **Nicoleta Tarfulea**, Purdue University Northwest, Hammond, USA

Title: **A hybrid mathematical model for cell motility in angiogenesis**

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Abstract: The process of angiogenesis is regulated by the interactions between various cell types such as endothelial cells and macrophages, and by biochemical factors. In this talk, we present a hybrid mathematical model in which cells are treated as discrete units in a continuum field of a chemoattractant that evolves according to a system of reaction-diffusion equations, whereas the discrete cells serve as sources/sinks in this continuum field. It incorporates a realistic model for signal transduction and VEGF production and release, and gives insights into the aggregation patterns and the factors that influence stream formation. The model allows us to explore how changes in the microscopic rules by which cells determine their direction and duration of movement affect macroscopic formations. In particular, it serves as a tool for investigating tumor-vessel signaling and the role of mechano-chemical interactions of the cells with the substratum.

MB21: **Anup Tuladhar**, Tribhuvan University, Kathmandu, Nepal

Title: **Transmission dynamics of co-existence of multiple strains of COVID-19 in Nepal**

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Coauthors: Jivandhar Jnawali, Kedar Nath Uprety, Naveen K. Vaidya

Abstract: The spread of COVID- 19 is one of the most devastating events affecting the human health. In this presentation, we discuss a model to describe the multi strains of COVID-19 (wild and mutated) transmission competing under with and without vaccination. We also present the simulation results to demonstration our idea and the utility of multiple strain model in the content transmission of COVID- 19 in Nepal.

MB22: **Ananta Upreti**, Tribhuvan University, Kathmandu, Nepal

Title: **Modeling of Transmission Dynamics of Dengue Infection in Kathmandu**

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Coauthors: Jivandhar Jnawali, Kedar Nath Uprety, Naveen Vaidya

Abstract: Dengue fever is a major public health issue in Nepal, with increasing incidence and prevalence over the years. Mathematical models are valuable to insight the dynamics of dengue transmission and assessing the potential impact of interventions. In this presentation, we will discuss a mathematical model incorporating the environmental factors to describe the spread of dengue in Kathmandu, Nepal during the year 2022 which is the largest outbreak in the history of Nepal. We also present the simulation results to assess the role of the environmental factors in particular sanitation of the town to boost up the proliferation of dengue in Kathmandu.

Probability and Statistics (ST)

ST1: **Krishna Acharya**, Tribhuvan University, Kathmandu, Nepal

Title: **Comparison of Logistic and Log-binomial Regression Model with Reference to Household Poverty of Nepal**

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Coauthors: Shankar Khanal, Devendra Chhetry

Abstract: According to previous studies, log-binomial regression model can be used an alternative to logistic regression model for commonly occurred event of outcome. Mostly, clinical and epidemiological data have been used to compare the performance of these two models. However, the use of log-binomial model and the comparison with logistic regression model for poverty data has not been discussed yet. The objective of this paper is to compare the logistic and log-binomial regression model in terms of variable selection, effect size, precision of effect size, goodness of fit test, diagnostics, model stability, and convergence failure problem. A nationally representative cross-sectional household level poverty data of size 5988 from Nepal Living Standard Survey 2010-11 is used for the analysis. The outcome of interest for each model is poor/ non-poor household. Both the models have selected same set of covariates; the effect size for each covariate in logistic regression model is overestimated, and yields wider confidence interval than that of log-binomial model. The elevation of risk varies from 13% to 173% while comparing the effect size. Both the models have satisfied the diagnostic tests, the stability test through bootstrapping resampling technique, and do not encountered failure convergence. However log-binomial model does not satisfy the goodness of fit test using H-L Chi-Square ($p = 0.0004$) test. Hence, logistic regression model seems to be better performer empirically satisfying every requirement, including the model's goodness of fit test than the log-binomial regression model with reference to household poverty data of Nepal.

Keywords: Log-binomial, logistic, poverty, stability, goodness of fit, diagnostics, failure convergence

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ST2: **Dipankar Bandyopadhyay**, Virginia Commonwealth University, Richmond, VA, USA

Title: **A Population-Based Study on the Effect of Smoking on Age-adjusted Lung Cancer Incidence using Bayesian Approach**

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Abstract: Tensor regression analysis is finding vast emerging applications in a variety of clinical settings, including neuroimaging, genomics, and dental medicine. The motivation for this talk is a study of periodontal disease (PD) with an order-3 tensor response: multiple biomarkers measured at prespecified tooth–sites within each tooth, for each participant. A careful investigation would reveal considerable skewness in the responses, in addition to response missingness. To mitigate the shortcomings of existing analysis tools, we propose a new Bayesian tensor response regression method that facilitates interpretation of covariate effects on both marginal and joint distributions of highly skewed tensor responses, and accommodates missing-at-random responses under a closure property of our tensor model. Furthermore, we present a prudent evaluation of the overall covariate effects while identifying their possible variations on only a sparse subset of the tensor components. Our method promises Markov chain Monte Carlo (MCMC) tools that are readily implementable. We illustrate substantial advantages of our proposal over existing methods via simulation studies and application to a real data set derived from a clinical study of PD. The R package BSTN available in GitHub implements our model.

ST3: **Ishwari Prasad Banjade**, Tribhuvan University, Kathmandu, Nepal

Title: **An Alternative Measuring Model for Human Development**

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Abstract: The concept of human development is relative over time. After 1990, the concept of human development came in to exist, which activated the dialogue and discussion on measuring human development which is prime issue and center of assessment in measuring human development. The proposed model which is based on the mapping HDI to Sustainable Development Goals (SDG) factors and derive the weight for chosen components using Laplace rule of probability. The Sustainable Development Goals (SDG) and human development cannot be separated to design the model. Hence new model should be based on all seventeen factors according to mapping concept with HDI to SDG (Louangrath, P. I, 2017). According to Maffey, G. 2015, Ranis, G. 2011, Lee, J. W. 2008, the technological adoption is important factor for the human development. The Laplace Rules of Success is act as a probability of success and calculated using P=(s+1)/(n+2) and weight is determined using probability. Previously only eight factors were address and nine factors were found missing in composite index and should be incorporated those missing components to design the new model to measure the level of human development. Here, $W_i = P_i / \sum(P_i)$, where, S=sample components, n = total factors of SDG , W=weight, P=chance of chosen factors. The model become $Y = a + \beta_i X_i$. Here $0 < n < 6$, the life expectancy, education, income, social as well as institutional governance and technological adoption are the proposed components for new model. Those components should make normalize and incorporated in model which will be more rational and reflective. The measurement process of human development required rational factors and weight to map with HDI to SDG factors. The derived model for measuring human development become: Y=a+ 0.14(X1=life expectancy)+0.16(X2=education) +0.19 (X3=income)+0.23(X4=Social governance) + 0.28(X5=Technological adoption).This model can be used for measuring the level of human development in rational manner.

Keywords: Human Development Index, Sustainable Development Goals, Statistical Techniques, Social Governance, Technological adaptation.

ST4: **Madhab Prasad Baral**, Tribhuvan University, Prithvi Narayan Campus, Pokhara, Nepal

Title: **Estimation of Migration Intention due to Climate Change through the Lens of Perception in Myagdi District**

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Abstract: Intentions are the first step that makes people decide on the actual migration process. The migration intention of people is affected by economic, sociocultural, demographic, and climatic variables. The main purpose of this study is to indicate the impact of climate change on the migration intention of the residents and to investigate the trends of climatic variables in the Myagdi district. To find the trends and magnitude of the climatic variables, Mann-Kendall and Sen's slopes are used. A five-point Likert scale is used to find the residents' perceptions about climate change and migration intention. This study indicates that the trend of minimum temperature in the monsoon season is positive and significant. The minimum temperatures in all other seasons are positive and insignificant. The maximum temperature in all other seasons except pre-monsoon season is positive and insignificant. The rainfall trend is positive only in the post-monsoon season and negative for other seasons with all insignificant values. The perceived values of the severity and variability indicate that the Myagdi district is highly vulnerable to climate change. The study also indicates that the impact of climate change like lack of daily needed foods, significant depletion of water resources, and destruction of land and property due to climatic disasters play a vital role to intensify the migration intention of residents.

Keywords: estimation, perception, migration intention, climate change, Myagdi district

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ST5: **Sumangal Bhattacharya**, Indian Institute of Technology Tirupati, Yerpedu, India

Title: **On Modeling Bivariate Lifetime Data in the Presence of Inliers**

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Abstract: In reliability, the lifetime data is usually modeled using one or two parametric distributions, such as Weibull, gamma, log-normal, Pareto, etc., which are unimodal by nature. Sometimes, the data may contain many zeros or close to zero data points, defined as inliers (instantaneous or early failure observations) in the literature. The usual modeling approach using the unimodal parametric distributions may not provide expected results for such data in the presence of inliers. Furthermore, correlated bivariate observations with inliers frequently occur in reliability; here, we propose a method of modeling bivariate lifetime data with instantaneous and early failure observations. We construct a new bivariate distribution function by combining bivariate uniform and Weibull distributions. The bivariate Weibull distribution is obtained using a 2-dimensional copula, assuming the marginal distributions as two parametric Weibull distributions. We derive some properties of that modified bivariate Weibull distribution, mainly the joint probability density function, the survival (reliability) function, and the hazard (failure rate) function. The model's unknown parameters are estimated using the Maximum Likelihood Estimation (MLE) technique combined with a machine learning clustering algorithm. Numerical examples are provided using simulated data to illustrate and test the performance of the proposed methodologies. The method is also applied to real data and compared with existing methods in the literature.

ST6: **Bijaya Bhattarai**, Central Department of Statistics, Tribhuvan University, Kathmandu, Nepal

Title: **Factors Affecting the Quality of Life of Elderly residents in Old Age Homes in Kathmandu District: A Cross Sectional Study**

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Coauthors: Ram Prasad Khatiwada

Abstract: Quality of life is a vital aspect of our existence, particularly for the elderly in our society. While the concept of quality of life is multifaceted and subjective, this study aims to investigate the factors that significantly impact the quality of life of the elderly living in old age homes in Kathmandu district. Using a cross-sectional research design, 172 participants from nine old age homes were interviewed, and their responses were analyzed using descriptive and inferential statistics. The results reveal that the majority of the elderly have a fair quality of life, while factors such as relatives' visits, the type of old age home, satisfaction with food and accommodation, and internal environmental factors have a significant impact on their quality of life. For instance, the odds of being in a lower category of quality of life are 7.121 times higher for those who are unsatisfied with their food and accommodation than those who are satisfied. Additionally, elderly individuals in government-run old age homes are 13.88 times more likely to have a lower quality of life than those in private homes.

The study findings provide valuable insights into the key factors that contribute to the quality of life of elderly individuals residing in old age homes. By identifying these factors, policymakers and healthcare providers can create targeted interventions that improve the quality of life of elderly residents. Ultimately, this research highlights the importance of addressing the multifaceted and subjective nature of quality of life and the need for tailored solutions that address the unique needs of elderly individuals in old age homes.

ST7: **Shilpi Biswas**, Indian Institute of Technology Guwahati, Guwahati, India

Title: **Analysis of load-sharing systems using a model with piecewise linear approximation to cumulative hazard**

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Coauthors: Ayon Ganguly, Debanjan Mitra

Abstract: In this work, we consider a parallel load-sharing system that consists of a certain number of components where the total workload is constant, and if components of the system fail one by one, then the workload redistributes among the surviving components, and hence loads on the remaining components increase. In this work, we describe a piecewise linear approximation (PLA) for the

cumulative hazard in load-sharing systems with unknown load-share rules. This model is data-driven and can be suitably tuned by choosing the number of linear pieces for the PLA. Maximum likelihood estimates (MLE) of the model parameters are obtained. Percentile bootstrap and bias-adjusted bootstrap methods are used to construct confidence intervals for model parameters. Monte Carlo simulations are performed to study the performance of inferential methods. The robustness of the model is also studied through detailed Monte Carlo simulations. The mean time to failure (MTTF), mean residual time (MRT), and reliability at a mission time (RMT) of the system for the proposed model are discussed. A real-data on two-component systems is thoroughly studied for illustrative purposes.

ST8: **John Borkowski**, Montana State University, Bozeman, MT, USA

Title: **A new particle swarm optimization algorithm for generating optimal mixture experiment designs based on the Aitchison geometry**

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Coauthors: Stephen Walsh

Abstract: In k-component mixture experiments, the component levels are not on an absolute scale (such as time, temperature, pressure). Rather, each component represents a proportion with the constraint that the sum of proportions equals one. This constraint creates a number of technical differences in the geometry of the design space and algorithms used to generate optimal designs. In this presentation, we develop methodology for implementation of particle swarm optimization (PSO) for optimizing functions with matrix inputs. To accomplish this, we take advantage of the Aitchison geometry, a non-Euclidean geometry defined on a simplex, and, given specific definitions of vector addition and scalar multiplication, a vector space is induced on the k-simplex. We then incorporate these definitions to the update equations in PSO for generating optimal mixture designs. We demonstrate that the resulting PSO algorithm can efficiently generate existing and new designs for various mixture experiment models. We also extend the approach to generation of mixture designs when the mixture components are subject to more restrictive lower and upper bounds.

ST9: **Sher Chhetri**, University of South Carolina Sumter, Sumter, USA

Title: **On Some Generalized Family of Probability Distributions**

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Coauthors: Gokarna Aryal

Abstract: Recently much efforts have been made to generalize a family of probability distribution. These studies are mainly motivated due to the need of modeling various types of data and to find their probabilistic structure. In this talk, we will present the usefulness of zero truncated Poisson (ZTP) distribution to develop different family of distributions including the Transmuted-G and Beta-G Poisson family. The efficacy of developing such models will be justified by illustrating two different real–life applications.

ST10: **Biraj Dahal**, Georgia Institute of Technology, Atlanta, USA

Title: **Numerically Solving PDEs with Neural Network Approximations**

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Abstract: Neural networks have recently been applied for approximating solutions to differential equations. In this talk, we will explore two such methods. First, we will discuss the use of neural networks as a surrogate model for solving physical problems based on data. Neural networks can learn the physical process from the data and interpolate it effectively. Second, we will solve

differential equations directly using a neural network to parametrize the solution. This approach does not use any data, it instead attempts to fit to the differential operator by minimizing a residual. Both of these methods show that machine learning can be useful tool for numerical solutions for physical systems.

ST11: **Ujjwal Prakash Dahal**, Tribhuvan University, kathmandu, Nepal

Title: **Study of client behavior for term deposit in the bank using Machine Learning Techniques**

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Abstract: Term deposits play a pivotal role in augmenting deposits in banks, and the present study aims to analyze clients who can potentially become term/fixed depositors. This study utilizes data from direct marketing campaigns of a Portuguese banking institution to gain insights into this subject matter. The primary objective of this research is to assist banks in attaining a better understanding of client behavior that leads to making consistent deposits over a prolonged period. The study employs different machine learning techniques to prognosticate client behavior and thus, to provide a more comprehensive view of the factors that underpin term depositors and decision-making process. To achieve the research goal, six diverse classification methods, including Logistic Regression, Linear Discriminant Function, Quadratic Discriminant Function, Naïve Bayes, Support Vector Machine, and Random Forest classification, are employed to forecast the potential of clients to become term depositors. The efficacy of these methods is assessed using both the accuracy and area under the ROC curve. The study finds that Random Forests outperformed other classification methods in terms of accuracy in predicting term depositor clients. However, Support Vector Machine, Logistic Regression, and Naïve Bayes classifiers also demonstrated excellent performance in this regard. These results hold the potential to guide banks in making more informed decisions about acquiring and retaining term depositors.

ST12: **Ishapathik Das**, Indian Institute of Technology Tirupati, Tirupati, India

Title: **A spatial copula interpolation in a random field with application in air pollution data**

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Abstract: Interpolating a skewed conditional spatial random field with missing data is cumbersome in the absence of Gaussianity assumptions. Copulas can capture different types of joint tail characteristics beyond the Gaussian paradigm. Maintaining spatial homogeneity and continuity around the observed random spatial point is also challenging. Especially when interpolating along a spatial surface, the boundary points also demand focus in forming a neighborhood. As a result, importing the concept of hierarchical clustering on the spatial random field is necessary for developing the copula model with the interface of the Expectation-Maximization algorithm and concurrently utilizing the idea of the Bayesian framework. This article introduces a spatial cluster-based C-vine copula and a modified Gaussian distance kernel to derive a novel spatial probability distribution. To make spatial copula interpolation compatible and efficient, we estimate the parameter by employing different techniques. We apply the proposed spatial interpolation approach to the air pollution of Delhi as a crucial circumstantial study to demonstrate this newly developed novel spatial estimation technique.

ST13: **Surakshaya Dhakal**, Central Department of Statistics, Tribhuvan University, Kathmandu, Nepal

Title: **Risk Factors for Post-Traumatic Stress Disorder (PTSD) in COVID Survivors: A Cross-Sectional Study**

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Abstract: The study aimed to investigate the impact of demographic, socio-economic, health, and lifestyle variables on the development of PTSD symptoms in COVID survivors. The study used a cross-sectional design, and data were collected via a standard set of questionnaires from 228 COVID survivors, who required oxygen support and were admitted to Damak COVID hospital from April to October 2021.

Descriptive statistics such as frequency and percentage were used to summarize the data and inferential statistics such as chi-square test, Fisher's exact test, and Binary logistic regression were used to analyze the data and to infer the overall result from the taken sample. The study found that only three variables, i.e., gender, diabetes, and chronic obstructive pulmonary disorder (COPD), were significant factors that posed a higher threat of PTSD in COVID survivors. Additionally, the study uses model adequacy tests such as Pseudo R2 test, Reliability test, Hosmer and Lemeshow, and Multicollinearity test to validate the model fitted. The study found that only three variables had significant impact PTSD symptoms in COVID survivors. Male patients were more likely to have PTSD symptoms than female patients. The presence of diabetes before or after the infection increased the risk of PTSD. The patients with high blood pressure before COVID and those who developed chronic obstructive pulmonary disorder (COPD) after COVID were more likely to experience PTSD symptoms. The study provides valuable information on the risk factors for developing PTSD symptoms in COVID survivors. This study can contribute to the understanding and growing body of research on the psychological impact of COVID and help healthcare professionals identify patients who are at risk of developing PTSD and provide them with appropriate interventions to prevent or treat PTSD.

ST14: **Tanujit Dey**, Harvard Medical School, Boston, USA

Title: **EM Based Approach for Analysis of Multiplatform Genomics Data**

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Abstract: Due to advances in biomedical technologies, it has become prevalent to collect biomedical data of the same patients from different platforms in clinical research, such as epigenomics, gene expression, and clinical features. Therefore it has become indispensable to develop statistical tools to analyze data collected from different platforms jointly to provide complementary information for a clinical study. This work proposes a two-stage hierarchical Bayesian model integrating high-dimensional biomedical data from diverse platforms to select biomarkers associated with the clinical outcomes of interest. Simulation studies suggest our model-based data integration method shows higher accuracy in selecting predictive variables. Moreover, accurate data analysis based on a Glioblastoma (GBM) dataset reveals our method's potential to detect genes associated with GBM survival, as most of the selected genes are reported to be crucial in the pathology of GBM in the existing literature.

ST15: **Arjun Kumar Gaire**, Khwopa Engineering College, Bhaktapur, Nepal

Title:**Ratio Exponentiated Log-logistic Distribution, Properties, and Performance Analysis**

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Abstract: Introduction of new family of distribution and its sub-models is the highly interested in the research of uni-variate probability distribution field. In this paper, Ratio Exponentiated Log-Logistic distribution has been proposed by choosing the Log-logistic distribution as a base in Ratio Exponentiated general family of distribution proposed by Bantan et al. (2020). Some

statistical properties of this new distribution have been derived. The model is applied to some real life time data sets to show the flexibility of model. The Akaike's Information Criteria (AIC), Bayesian Information Criteria (BIC), the chi-square test statistics, and coefficient of determination, have been used to test the significance of fitting the data sets. This model is found to be flexible to fit these data sets.

ST16: **Ram C. Kafle**, Sam Houston State University, Huntsville, USA

Title: **A two-stage Bayesian joinpoint regression model and its application in epidemiological studies**

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Abstract: The joinpoint regression model is a piecewise regression models which identify significant changes in the trends of incidence, mortality, and relative survival of a disease in a given population. The Bayesian approach of joinpoint regression is widely used in modeling epidemiological data to identify the points in the line where the disease trend shift. In this study, we present an approach to jointly model two longitudinal processes of a disease in which the time lag is an important parameter to identify the cause of the disease. The resulting second stage model estimates and predicts the rate of change of disease with lag parameter.

ST17: **Bishal Kumar Khadka**, Nexus Institute of Research and Innnovation (NIRI), Lalitpur, Nepal

Title: **Identifying novel genes involved in Cholangiocarcinoma using Genome-wide methylation analyses from the patients' tumor samples**

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Coauthors: Jeebana Bhandari, Tara Sigdel, Keshav Pokhrel, Milan Bimali, Ram P Khatiwada, Ram Kafle, and Rajendra P Pangeni

Abstract: Cholangiocarcinoma (CCA), a type of gall bladder adenocarcinoma (GBAC) is one of the cancer types that affects the bile ducts. Bile ducts are the tubes that carry bile from the liver to the small intestine. CCA may occur anywhere along the bile ducts, both inside and outside the liver. CCA is a rare but aggressive cancer with limited treatment options and a poor clinical prognosis. Epigenetic alterations, such as DNA methylation, have emerged as promising targets for many types of cancer but it has not been studied well in CCA. In this study, we carried out genome wide DNA methylation data analyses using the samples from The Cancer Genome Atlas (TCGA) between the normal tissues and tumor samples from CCA patients to identify novel genes that could be developed either as a panel of biomarkers for early prognosis or as therapeutic targets for CCA. Our preliminary analyses have identified 10930 DNA methylated sites (CpG sites) across the genome, of which 9762 were hypermethylated and 2168 probes were hypomethylated in primary CCA tumors compared to the normal tissues. On further filtering using stringent screening criteria, we have identified top 38 hypermethylated and 41 hypomethylated sites that we are planning to take it for downstream analyses. Our further plan is to analyze RNA sequencing data to interrogate if the expression of these genes correlate to their methylation status, and to carry out pathways and survival analyses to investigate molecular pathways and clinical prognosis associated with these genes in CCA patients. Our long-term goal is to develop these candidate genes as novel epigenetic markers and/or as therapeutic targets for cholangiocarcinoma patients.

Keywords: Cholangiocarcinoma, Gall Bladder Cancer, DNA methylation, biomarkers, therapeutic targets,

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ST18: **Netra Khanal**, University of Tampa, Tampa, USA

Title: **Scouting the Choice of Laplace Family of Probability Distributions to Facilitate Stock Returns Modeling-An Empirical Inquiry**

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Abstract: Investment in stocks and shares aims to seek potential gains while weighing the risk of future needs, such as retirement, children's education etc. Analysis of the behavior of the stock market returns and making prediction is important for investors to mitigate risk on investment. Historically, the normal variance models have been used to describe the behavior of stock market returns. However, the returns of the financial assets are actually skewed with higher kurtosis, heavier tails, and a higher center than the normal distribution. The Laplace distribution and it's family are natural candidates for modeling stock returns. The Variance-Gamma distribution is the most sought after distribution for modeling asset returns and has been extensively talked in financial literature. In this paper, we explore the other Laplace family, such as Asymmetric Laplace, Skewed Laplace, Kumaraswamy Laplace together with Variance-Gamma to model the weekly returns of the S&P 500 Index and it's eleven business sector indices. Our empirical inquiry shows that Kumaraswamy Laplace distribution performs better for stock returns modeling among the choice of distributions used in this study.

ST19: **Chhatra Bahadur Limbu**, Central Department of Statistics, TU, Kathmandu, Nepal

Title: **Factors Associated with Smartphone Addiction among High School Students in Dharan sub-metropolitan city, Sunsari**

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Abstract: The use of smartphones has become increasingly popular among adolescents in recent years. Their excessive use of smartphones has become an addiction. Addiction interferes with or affects various aspects, such as behavior, academic performance, relationships, and overall health and well-being. This study aims to determine the prevalence of smartphone addiction and identify the factors associated with smartphone addiction among high school students in the Dharan sub-metropolitan city. A cross-sectional survey was conducted among 391 high school students using a self-administered questionnaire. The questionnaire included inquiries relating to demographic and socio-economic factors, academic performance, smartphone usage, purposes, and lifestyle behaviors. The prevalence of smartphone addiction was determined through a short version of the smartphone addiction scale (SAS-SV), which is the standard tool that consists of 10 questions. To collect all the necessary information, Kobo Toolbox was used. SPSS software was used as a tool for descriptive and inferential analysis. An ordinal regression analysis was used to assess the significant factors associated with smartphone addiction. Smartphone addiction among high school students was estimated at over 50%, with a high percentage of females in this study and 35.8% of them being high-risk. The study examined significant factors such as grade, gender, phone ownership, study pressure, study satisfaction, permission, preference, and habitual differences that could potentially affect smartphone addiction. The results indicated that grade, gender, study satisfaction, preference, and habitual differences were significantly associated with smartphone addiction. Furthermore, students who reported higher levels of study pressure and lower levels of study satisfaction were more likely to be addicted to smartphones.

These findings highlight the need for targeted interventions to address smartphone addiction among high school students, particularly those who experience high levels of study pressure and lower levels of study satisfaction. To promote appropriate and healthy use of smartphones among students, the study suggests that effective strategies should be promoted across all educational settings.

Keywords: Smartphone addiction, high school students, smartphone usage, factors associated

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ST20: **Ganesh Malla**, University of Cincinnati-Clermont, Cincinnati, USA

Title: **A New Test for New Better Than Used in Expectation Lifetimes**

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Abstract: There is a large body of literature on testing exponentiality against New Better Than Used in Expectations (NBUE) alternatives. So far, power studies of these tests have been confined to Increasing Failure Rate (IFR) alternatives, a very narrow subset of the NBUE alternatives. In this paper we have initiated a study of powers for much broader sets of alternatives, including ones with discontinuous Survival Functions (SFs). We have also introduced a new Kolmogorov Smirnov type sup-test that is much more powerful against large classes of alternatives than some of the best tests known. Also, it is not much worse than the integral tests for IFR alternatives.

ST21: **Somabha Mukherjee**, National University of Singapore, Singapore, Singapore

Title: **High Dimensional Logistic Regression Under Network Dependence**

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Abstract: The classical formulation of logistic regression relies on the independent sampling assumption, which is often violated when the outcomes interact through an underlying network structure, such as over a temporal/spatial domain or on a social network. This necessitates the development of models that can simultaneously handle both the network peer-effect (arising from neighborhood interactions) and the effect of (possibly) high-dimensional covariates. In this talk, I will describe a framework for incorporating such dependencies in a high-dimensional logistic regression model by introducing a quadratic interaction term, as in the Ising model, designed to capture the pairwise interactions from the underlying network. The resulting model can also be viewed as an Ising model, where the node-dependent external fields linearly encode the high-dimensional covariates. We use a penalized maximum pseudo-likelihood method for estimating the network peer-effect and the effect of the covariates (the regression coefficients), which, in addition to handling the high-dimensionality of the parameters, conveniently avoids the computational intractability of the maximum likelihood approach. Our results imply that even under network dependence it is possible to consistently estimate the model parameters at the same rate as in classical (independent) logistic regression, when the true parameter is sparse and the underlying network is not too dense. Towards the end, I will talk about the rates of consistency of our proposed estimator for various natural graph ensembles, such as bounded degree graphs, sparse Erdos-Renyi random graphs, and stochastic block models, which follow as a consequence of our general results. This is a joint work with Ziang Niu, Sagnik Halder, Bhaswar Bhattacharya and George Michailidis.

ST22: **Chandan Pal**, Indian Institute of Technology Guwahati, Guwahati, India

Title: **Discrete-time zero-sum games for Markov chains with risk-sensitive average cost criterion**

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Abstract: We study zero-sum stochastic games for controlled discrete time Markov chains with risk-sensitive average cost criterion with countable/compact state space and Borel action spaces. The payoff function is nonnegative and possibly unbounded for countable state space case and for compact state space case it is a real-valued and bounded function. For countable state space case, under a certain Lyapunov type stability assumption on the dynamics we establish the existence of the value and a saddle point equilibrium. For compact state space case we establish these results without any Lyapunov type stability assumptions. Using the stochastic representation of the principal eigenfunction of the associated optimality equation, we completely characterize all possible saddle point strategies in the class of stationary Markov strategies. Also, we present and analyze an illustrative example.

ST23: **Katarína Petrlová**, Silesian University in Opava, Opava, Czech Republic

Title: **Use of the Bayesian Network in Crisis Management With a Focus on Secondary Crisis Events**

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Abstract: A crisis event is a complex, difficult to predict and dangerous state in nature, in the life of a society or in the operation of technical systems with negative consequences on the function or existence of the system. Under certain circumstances, one crisis event may trigger secondary crisis events that affect public health on a large scale. In order for the system to be ready to face secondary crisis events, it is necessary to determine the probability of their occurrence. The article is focused on the use of the Bayesian network in determining the probability of the occurrence of secondary crisis events. The Bayesian network structure itself is a suitable tool for constructing the necessary probability distributions. This approach makes it possible to set up processes for managing the crisis event more effectively and to improve the preparedness of crisis managers in protecting the population.

ST24: **Vikash Raj Satyal**, Kathmandu University, Dhulikhel, Nepal

Title: **Treating the Outliers**

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Abstract: Outliers are the most nasty observations in data modeling. OLS consider them most serious problem that needs to be treated properly before data analysis. However, in many cases properly identifying and understanding them may reveal very interestingly and unnoticed description of the data that could give additional information to the researcher.

Keywords: outliers, R , data modeling, Lowess

ST25: **Kiran Kumar Shrestha**, Kathmandu University, Dhulikhel, Nepal

Title: **Comparative Study To Assess Risk in Finance and Production Categories of NEPSE Market Using ARIMA Model**

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Abstract: The study of risk in investing in stock market has always been an influencing area for many researchers worldwide since last few decades. The main source of risk in investing in stock market is the fluctuations in the price of stocks, which are random in nature. Different companies enlisted in Nepal Stock Exchange (NEPSE) market are categorized into ten groups: (i) Banking (ii) Trading (iii) Hotel and tourism (iv) Development Bank (v) Hydropower (vi) Finance (vii) Microfinance (viii) Non-life Insurance (ix) Life Insurance (x) Manufacturing and Production. Values of daily indices for these ten groups are available online from http://www.nepalstock.com, the official website of NEPSE.

In current research an attempt has been made to assess the risk present in these groups by classifying them into two categories (a) Finance (b) Production. The groups 'Banking', 'Development Bank', 'Finance', 'Microfinance', 'Non-Life-Insurance' and 'Life-Insurance' are placed in 'Finance' category. Similarly, the groups 'Trading', 'Hotel and Tourism', 'Hydropower' and 'Manufacturing and Product' are placed in 'Production' category. The day-wise means of indices for these two categories are calculated to determine which group is riskier for investment. The test of stationarity of average indices of these two categories, using Augmented Dickey-Fuller test indicated data these values are non-stationary for both. However, applying the test to the daily fluctuations showed that the first differences of the values are stationary. Then several auto-regressive integrated moving-average (ARIMA) models are fitted to daily fluctuations and it is found that ARIMA(1, 1, 1)

is the best model for 'Finance' category and ARIMA(3, 1, 2) is the best model for 'Production' category. The study of variance of error terms of the models revealed that there is greater risk 'Finance' category with variance of error term measuring 7627, whereas, the variance of residuals for 'Production' category is observed to be 1287. Moreover, observation on value-at-risk, using historical data to determine 95% confidence interval for daily fluctuations in indices also showed that 'Finance' category owes greater risk with width of 5284.36, whereas, the confidence interval for 'Production' category is found to have width of 2780.61. Thus it is concluded that 'Finance' category of NEPSE market possess more risk compared to 'Production' group. It simply means there is greater chance of losing as well as greater chance of gaining in investing in 'Finance' group in comparison to 'Production' group. The decision to invest in companies belonging to these two categories depend on how much risk one desires to hold.

ST26: **Radhika Sigdel**, Balkumari College, Bharatpur, Nepal

Title: **Teaching Qualities and Perception towards Finance Professor by BKC Students': Self- Appraisal Study**

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Abstract: This study studied the perception of Balkumari College (BKC) students' towards finance professors (FP) also examining the teaching qualities. The aim of this study was to identify the level of perception, teaching quality, and behavior of FP and tried to find out that how the FP's communication skills, topics presentation, and guidance towards students was. The population of the study compared all students of BKC. The study sample consisted 376 students selected through the cluster and simple random sampling techniques from the Campus domain mail. The cross-sectional survey design was used and 26.06 % of data was collected from 24 self-made Five Likert scale (very poor to excellent) by questionnaires through a google form. Data were analyzed by descriptive statistics using SPSS 20. The total number of male respondents were 72.20%, 70.20% were first-year and 57.6% were BKC students. The descriptive statistic showed the class management was more consistent than other teaching qualities and that FP was friendly, never rude and biased but proud. We concluded that professors should be well communicating, presenting the subject matter confidently, motivating towards research activities, and behave friendly and peaceful.

Keywords: Perception, communication skill, teaching quality and behaviors.

ST27: **Bhikhari Tharu**, Spelman College, Atlanta, USA

Title: **Changing seasonality of precipitation extremes for the USA and possible connections with large-scale climate patterns**

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Abstract:Temporal changes in the seasonality of extreme precipitation, and its possible teleconnections to large-scale climate patterns are not well understood. In this study, we investigated temporal changes in the seasonality of Annual Daily Maximum (ADM) and Monthly Maximum (MM) precipitation indices over 1951 – 2014 for 1108 stations across the contiguous USA using circular statistics. Our results show that many climate regions within the contiguous USA display distinct seasonality patterns for both ADM and MM. While a spatial coherence of change in the mean date of occurrence of extreme precipitation across a large area is not visible, a cluster of stations showing a decrease in strength of seasonality for the recent time period is concentrated in the eastern Gulf Coast as well as coastal sites of Northeast and Northwest regions.

ST28: **Rajendra Prasad Upadhayaya**, Tribhuvan University, Prithvi Narayan Campus, Pokhara, Nepal

Title: **Climate Change and Its Impact on Tourism Quality of Life (QOL) in Mustang District of Nepal**

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Abstract: The tourism industry is highly sensitive to changes in climate and impacts the quality of life of people who rely on tourism for their livelihoods. Climate change negatively impacts tourism demand and economics and social life The main purpose of tourism development is to improve the quality of life of the host community as well as to gain foreign currency. This study aims to identify the impact of climate change on tourism and assess the quality of life (QOL). The study applied Sirgy and Cornell's community model and modified the measurement approach based on residents' perceptions of the importance, satisfaction, and impact of tourism. This study indicates that the impact of climate change on tourism is very less but they perceived that tourism is severely affected in coming decades and are more aware of it. The QOL model indicated that the residents were satisfied with the tourism business and interested in further investment in tourism developments.

Algebra and Topology (AT)

AT1: **Thaneshwor Bhandari**, Tribhuvan University, Kathmandu, Nepal

Title: **Some Continuous Properties in Fuzzy Metric Space**

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Abstract: This paper deals with the concept of fuzzy metric space and their basic topological properties, with illustrative examples. Also we denote continuous mappings from a fuzzy metric space (X; M; *) into a fuzzy metric space (Y; N; *), and prove some basic properties of continuous mappings including the composition function of two fuzzy continuous functions is proved to be a fuzzy continuous function.

AT2: **Anirban Dawn**, University Of Tampa, Tampa, USA

Title: **Laurent Series in Spaces of Holomorphic Functions**

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Abstract: Let X be a linear space of holomorphic functions on a Reinhardt domain in $\mathbb{C}^n$. We study the convergence and summability (in the topology of X) of Laurent series of functions in X. We introduce the principle of missing monomials and discuss some of its applications. We also discuss the notions of absolute and unconditional convergence of Laurent series in locally convex spaces and show that holomorphic functions smooth up to the boundary have Laurent series which converge unconditionally.

AT3: **Menassie Ephrem**, Coastal Carolina University, Conway, USA

Title: **On Labeled Graph C*-algebras**

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Abstract: Given a directed graph E and a labeling $\mathcal{L}$, one forms the labeled graph C^*-algebra by taking a weakly left–resolving labeled space $(E, \mathcal{L}, \mathcal{B})$ and considering a universal generating family of partial isometries and projections. In this talk, we describe the ideals for a labeled graph C^*-algebra when the graph contains sinks. Using some of the tools we build, we compute $C^*(E, \mathcal{L}, \mathcal{B})$ when E is a finite graph.

AT4: **Gokul K.C.**, Kathmandu University, Dhulikhel, Nepal

Title: **Post-Quantum Cryptography: A review**

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Abstract: Quantum theory is a branch of physics which deals in the tiny world of atoms and the smaller (subatomic) particles inside them. Quantum computing is a multidisciplinary field comprising aspects of computer science, physics, and mathematics that utilizes quantum mechanics to solve complex problems. Quantum computers are able to solve certain types of problems faster than classical computers by taking advantage of quantum mechanical effects, such as superposition, entanglement and de-coherence. It is believed that quantum computers are 100 million times faster than a regular computer chip. Quantum computers can solve problems that are impossible or would take a traditional computer an impractical amount of time (a billion years) to solve. Quantum computers will change the landscape of data security. Quantum computers will be able to break many of the public-key cryptosystems currently in use. This would seriously compromise the confidentiality and integrity of digital communications. In 1994 Peter Shor found

quantum algorithms for factoring and discrete log, and these can be used to break the widely used RSA cryptosystem, Diffie-Hellman(DH) key-exchange and elliptic curve cryptography(ECC) using a quantum computer. Understanding which cryptosystems are secure against quantum computers is one of the fundamental questions in the field. Another most obvious question this raises is what cryptosystems to use after quantum computers are built. The problem with currently popular algorithms is that their security relies on one of three hard mathematical problems: the integer factorization problem, the discrete logarithm problem or the elliptic-curve discrete logarithm problem. The goal of post-quantum cryptography (also called quantum-resistant cryptography) is to develop cryptographic systems that are secure against both quantum and classical computers, and can interoperate with existing communications protocols and networks.

In this paper, we will discuss about quantum computing, current cryptographic systems and possible post-quantum cryptography(PQC) schemes.

AT5: **Wolf-Dieter Richter**, Institute of Mathematics, University of Rostock, Rostock, Germany

Title: **Non-classically generalized complex numbers**

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Abstract: If one renounces the property of distributivity of addition and multiplication in a generalized complex number system, on the one hand the property of the number system to be algebra becomes impossible, but on the other hand almost endless possibilities for the introduction of new generalized complex number systems open up.

While for fixed z_2 the multiplication of two ordinary complex numbers $z_k = (x_k, y_k)^T = x_k + iy_k \in \mathbb{C}, k = 1, 2$ can be viewed as a linear mapping

$$z_1 \to z_1 \odot z_2 = \begin{pmatrix} x_2 & -y_2 \\ y_2 & x_2 \end{pmatrix} \begin{pmatrix} x_1 \\ y_1 \end{pmatrix},$$

a so-called rotational stretching, the multiplication of p-generalized complex numbers defined in [2, 3] is a non-linear mapping

$$z_1 \to z_1 \odot_p z_2 = \frac{|z_1|_p |z_2|_p}{|z_1 \odot z_2|_p} \begin{pmatrix} x_1x_2 - y_1y_2 \\ x_1y_2 + x_2y_1 \end{pmatrix}$$

where $|z|_p = (|x|^p + |y|^p)^{\frac{1}{p}}$ denotes a norm if $p \geq 1$ and, in the sense of [1], an antinorm if $0 < p \leq 1$ and a semi-antinorm if $p < 0$. If one uses an even more general product from [2], then the possibilities of applying mathematics to non-linear sciences are significantly expanded. In particular, generalizations of Euler's formula allow applications to the theory of directional probability distributions.

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AT6: **Alexander Schmitt**, Freie Universität Berlin, Berlin, Germany

Title: **The moduli space of singular principal bundles over the moduli space of stable curves**

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Coauthors: Ángel Muñoz Castañeda

Abstract: In the study of moduli spaces of vector or principal bundles over smooth projective curves and their properties, one may use degenerations to singular curves. An example for this approach is Gieseker's [4] proof of a conjecture by Newstead and Ramanan [9] in the rank two case. Motivated by this, Bhosle [3] and the speaker [11] constructed moduli spaces of singular principal bundles over irreducible curves with only nodes as singularities. The analog for reducible curves has been considered in the thesis of Ángel Muñoz Castañeda [6].
For a given semisimple structure group G and genus $g \geq 2$, there is a universal moduli space $\mathcal{M}_{g,G}$ of semistable principal G-bundles over the moduli space $\mathcal{M}_g$ of smooth curves of genus g. Using the aforementioned results, Muñoz Castañeda and the speaker [7, 8] constructed a moduli space of singular principal G-bundles on stable curves which compactifies $\mathcal{M}_{g,G}$ relative to the moduli space $\overline{\mathcal{M}}_g$ of stable curves, generalizing Pandharipande's [10] construction for the structure group GL_n. Compactifications of $\mathcal{M}_{g,G}$ which are flat over $\mathcal{M}_g$, but do not have a modular interpretation were obtained by Manon [5] and Belkale/Gibney [2] for the structure group $G = \mathrm{SL}_n$, and by Wilson [12] for simple and simply connected Lie groups of type A or C, using vector bundles of conformal blocks. Anderson, Esole, Fredrickson, and Schaposnik [1] have raised similar questions for Higgs bundles in view of possible applications to string theory.
In this talk, I will present the joint work with Muñoz Castañeda and briefly discuss Wilson's work on the relation of our moduli space and conformal blocks.

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AT7: **Laszlo Szalay**, University of Sopron, Sopron, Hungary

Title: **Generalized Lucas numbers in the closeness of 2^m**

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Abstract: Assume that $k \geq 2$ is a given positive integer. The k-generalized Lucas sequence $\{L_n^{(k)}\}_{n\geq 0}$ has positive integer initial values k, 1, 3, ..., $2^{k-1}-1$, and each term afterward is the sum of the k consecutive preceding elements:

$$L_n^{(k)} = L_{n-1}^{(k)} + L_{n-2}^{(k)} + \cdots + L_{n-k}^{(k)}.$$

An integer n is said to be close to a positive integer m if it satisfies $|n-m| < \sqrt{m}$.

In the talk, we solve completely the diophantine inequality

$$\left| L_n^{(k)} - 2^m \right| < 2^{m/2}$$

in the non-negative integers k, n, and m. This problem is equivalent to the resolution of the equation $L_n^{(k)} = 2^m + t$ with the condition $|t| < 2^{m/2}$, $t \in \mathbb{Z}$.

We also discovered a new formula for $L_n^{(k)}$ which was very useful in the investigation of one particular case of the problem.

This is joint work with A. Açikel and N. Irmak. For L. Szalay the research was supported by National Research, Development and Innovation Office Grant 2019-2.1.11-TÉT-2020-00165, by Hungarian National Foundation for Scientific Research Grant No. 128088, and No. 130909, and by the Slovak Scientific Grant Agency VEGA 1/0776/21.

AT8: **Bal B. Tamang**, Tribhuvan University, Kathmandu, Nepal

Title: **Application of the Quadratic Reciprocity Law in the Quadratic Diophantine Equations**

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Coauthors: Ajaya Singh, Manoj Gyawali

Abstract:In the paper, the Legendre symbol, the Euler criterion, and the Gauss lemma are used to discuss the quadratic reciprocity law. The quadratic reciprocity law is a modular arithmetic that establishes requirements for solving quadratic Diophantine equations modulo prime numbers. Euler, Legendre, and Gauss observed and Gauss proved the quadratic reciprocity law. Gauss lemma is a fundamental lemma that is used in the proofs of quadratic reciprocity law. Using the Legendre symbol and the quadratic reciprocity law, we discuss some results and consequences in quadratic Diophantine equations. Moreover, we discuss the relationship between quadratic residue, the Legendre symbol, continued fraction and use these tools to find the solution of the quadratic Diophantine equations.

Mathematical Education (ME)

ME1: **Arjun Adhikari**, Valmeeki Vidhyapith, Kathmandu, Nepal

Title: **A study of ancient trigonometry**

Email: arjunadhikari578@gmail.com

Coauthors: Eka Ratna Acharya

Abstract: Trigonometry is the basic needs for natural phenomena such as to measure the distance between two places, height of very huge objects, to measure the distance of stars from the earth and in the satellite navigation system also. To enhance the natural phenomena in mathematical model, trigonometry plays an important role. In this study we elaborate modern mathematical tools and techniques with the help of ancient trigonometry.

ME2: **Rameshower Aryal**, Kathmandu University, Kathmandu, Nepal

Title: **Developing and Implementing STEAM Integrated Project Plan: Opportunities and Challenges**

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Coauthors: Indra Mani Shrestha

Abstract: The aim of the study is to investigate the utilization of STEAM, Project Based Learning as a means of enhancing students' mathematical literacy and connecting it with other subjects. The study involved 75 students, six teachers, and two researchers from a school in the Kathmandu Valley, using "garbage collection as a way of making connections to real-life situations and encouraging critical thinking". The researchers sought to investigate how the integration of STEAM was incorporated into the learning process of "garbage collection to promote effective disposal". This project based STEAM visionary plan is based on how the students were deeply involved in their pedagogical practices and tried to make a vision that might be related to their learning world. The special objectives of the plan is, "With creatively and actively facilitates the students to understand the concept, effectively conduct project and meaningful completion of the implanted project plans with intended learning outcomes". This study employed a qualitative approach to explore how STEAM was integrated into Mathematics, Science, Social Studies, English, and Nepali subjects, with an emphasis on encouraging deep engagement, creative and critical awareness, and ultimately higher-level thinking. However, the study encountered ample challenges in integrating Mathematical concepts with other STEAM-related subjects and aimed to empower both students and teachers those who participated in the project and promoting critical thinking and deep engagement. Integrating such affective components into pedagogical practices by engaging the young brain of the children by promoting creativity, introducing novelty, and reducing stress on learning might improve long-term memory, and make teaching/learning more interesting, thereby promoting holistic education and might be an innovative alternative pedagogical model, which appears to be STEAM education.

ME3: **Deepak Basyal**, Coastal Carolina University, South Carolina, USA

Title: **Fractions in Elementary Textbooks of the USA and Nepal**

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Abstract: Studies show that difficulties in learning fraction concepts in early grades can inhibit students' ability to learn further mathematical concepts. Previous research has established that investigating instructional materials such as textbooks can provide valuable insights that are useful in effective teaching and learning and future curriculum updates. Therefore, we conducted a study comparing the treatment of fractions in elementary textbooks from the USA and Nepal. Everyday Mathematics, published by McGraw Hill (USA), and My Mathematics, published by the Curriculum Development Center (Nepal), were used as the sample for this study. Preliminary

results indicate that students in Nepal and the USA have varying opportunities to learn fractions. The American textbook is relatively larger and contains more fraction problems than the Nepali textbooks. Both textbooks aim to develop a conceptual understanding of fractions by using pictures and real-life contexts in the problems. However, Nepali textbooks predominantly use the part-whole sub-construct of the fraction concepts, while American textbooks utilize all five sub-constructs (part-whole, ratio, operator, quotient, and measure) in their problems. The implications of this study on the teaching and learning of fraction concepts will be discussed.

ME4: **Harsh Bahadur Chand**, University Central Campus, Far Western University, Mahendranagar, Nepal

Title: **Journeying Towards the Field of Conceptual Understanding: Teaching Real Analysis Concepts**

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Coauthors: Bal Chandra Luitel, Binod Prasad Pant

Abstract: I have been teaching the course Real Analysis (RA) at the undergraduate level for five years. But I was not satisfied with the performance of students in this subject before conducting this research. Similarly, several kinds of literature indicate that many students from Nepal and beyond perform poorly in RA. In this regard, I reflected upon my approach to teaching and observed the question papers of three of the Universities of Nepal. I realized that my pedagogical approach was focusing on procedural understanding and the evaluation system of different Universities is also largely devoted to measuring the procedural understanding of students. Thinking that one of the reasons behind the poor performance of students in RA might be ignorance of conceptual understanding of students, I asked myself a question 'how can I teach RA concepts for conceptual understanding of undergraduate students?' As a result, I decided to facilitate undergraduate students in developing a conceptual understanding of RA concepts. Accordingly, I became engaged for 15 days in facilitating undergraduate students in developing a conceptual understanding of RA concepts such as limit, continuity, derivative, and Riemann integral of a function through 'drawing and Geogebra integrated inquiry-based approach'. To share both my journey toward the field of conceptual understanding and the transformations that I observed, I followed auto/ethnography as a research method under the interpretive and critical research paradigms. Social constructivism and transformative learning theory were used as the theoretical basis. I reflected critically upon the content, process, and assumptions, of this 15 days journey, which resulted in the transformation of my frame of reference regarding pedagogical approach. Further, I observed a good conceptual understanding of RA concepts as well as the transformations in their disempowering belief regarding the understanding of RA concepts. The findings of this study might help mathematics teachers to teach concepts of RA in a meaningful way so that conceptual understanding may be ensured.

Keywords: Real Analysis concepts; Social constructivism; Transformative learning; Conceptual understanding; Inquiry based learning

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ME5: **Parshuram Chaudhary**, Nepal Sanskrit University, Janata Campus, Tulsipur, Dang, Nepal

Title: **Ethnomathematics in Traditional Grain Storage Materials in Tharu's Community**

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Coauthors: Dinesh Panthi

Abstract: Tharu's is one of the indigenous communities having their distinctive culture and practices. For doing daily tasks, they have developed their own mathematical conceptions and ideas. Ethnomathematics is the study of mathematical concepts and knowledge that are applied by a specific group of people but are typically not covered in the formal curriculum. This study is intended to uncover the mathematical concepts embedded in traditional grain storage materials

like Dehai, Kuthali, and Bhakari in Tharu's comminity. For this purpose, this research carried out the observation and documentation analysis method for data collection. To make it easier to create the art, structures, and designs of making systems of the traditional grain storage materials such as Dehai, Kuthali, and Bhakari in Tharu's comminity, the image of traditional grain storage materials such as Dehai, Kuthali, and Bhakari in Tharu's community has been redrawn from the field data. When it comes to making Dehai, Kuthali, and Bhakari in Tharu's comminity have developed a great deal of local knowledge that is based mainly on intuition, estimation, observation, and practice that has been transmitted down from generation to generation and is strongly tied to their local culture. In the interest of exploring the mathematical concepts incorporated into the creation of Dehai, Kuthali, and Bhakari in Tharu's comminity, emic ethnomodeling is applied. The findings showed that the Dehai, Kuthali, and Bhakari exhibit sophisticated geometrical objects, such as angles, lines, parallel lines, rectangles, circles, cylinders, prisms, pyramids, the concept of symmetry, reflection, and more.

ME6: **Sher Chhetri**, University of South Carolina Sumter, Sumter, USA

Title: **A Comparison of Three Instructional Methods for Teaching an Introductory Statistics Course**

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Coauthors: Mario Toussaint, Becky Hillman

Abstract: Determining the most effective course delivery method plagues faculty and universities worldwide. In this study, we discuss three delivery methods offered for the same course at a university prior to the COVID-19 pandemic and compare the data collected from each method: face-to-face, targeted flipped, and fully online. Even though the overall grades are slightly better in the face-to-face class than in the targeted flipped and online classes, the survey results showed that students in the targeted flipped class had the highest level of satisfaction, followed by those in the face-to-face class and the fully online class. The results of the study will also be used to discuss several strategies for improving student learning in targeted flipped, and fully online introductory level mathematics and statistics courses.

ME7: **Niroj Dahal**, Kathmandu University School of Education, Hattiban, Lalitpur, Nepal

Title: **Enghancning Students' Self- and Peer-Assessment Skills in High School Mathematics Through Workshop Activity**

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Coauthors: Bal Chandra Luitel, Binod Prasad Pant, Indra Mani Shrestha

Abstract: In this study, we used a self- and peer-assessment activity on Moodle to assess the self- and peer-assessment skills of Grade X students in mathematics, including arithmetic, algebra, statistics, and geometry, as prescribed by the curriculum development center of Nepal. The activity involved uploading answer sheets of 24 questions in PDF format to the Moodle platform, where they were graded by peers using a rubric or marking scheme determined by the mathematics teacher and approved by the teacher. The goal of the study was to find out about this activity among 18 of the 40 SEE-appearing students (10 boys and 8 girls) in the Uranite and Opel sections of one of the schools in the Kathmandu Valley, Nepal. The study employed an action research methodology, which involved planning interventions, implementing them, assessing their effectiveness, and discussing the lessons learned. The findings showed that the workshop activity had a lot of potential, and this article explores some of its unique aspects and potential uses within various theoretical frameworks. The article also outlines the opportunities and challenges of self- and peer-assessment in the contents of mathematics, which can enhance students' mathematical abilities in the classroom and raise their interest in the subject. The study found that using evaluation criteria to assess the work of peers can help students hone their analytical and evaluative skills. The discussions indicate that students

are proactive in their learning, can critically assess their progress, and use a collaborative, multi-faceted approach to learning. We landed this paper by arguing that self- and peer-assessment is a useful tool for engaging students in mathematics through self- and peer-assessment and evaluation in school mathematics.

ME8: **Paul Christian Dawkins**, Texas State University, San Marcos, TX, USA

Title: **Using set-based reasoning to support undergraduate students' construction of logic for proof-based mathematics learning**

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Coauthors: Kyeong Hah Roh

Abstract: Through iterative teaching experiments, we have designed a teaching sequence to help undergraduate students learn mathematical logic to help them transition into proof-based mathematics courses. Our approach differs from the conventional approach using truth-tables because we have found that this approach is less compatible with the way students reason about mathematical language prior to instruction. We instead build the truth conditions of statements around truth sets, which is more consistent with the ways that students interpret mathematical statements as referring to mathematical objects. Another benefit of our approach is that we teaching using meaningful statements and proofs to help students link their understanding of logic with their reasoning about specific mathematical topics (e.g., linking syntax and sematics). Our talk will summarize our teaching approach citing research findings about student reasoning that justify its value and portray its fruitfulness.

ME9: **Menaka Devkota**, Kathmandu University School of Education, Lalitpur, Nepal

Title: **Vygotsky's Scaffolding Approach for Effective Mathematics Learning: An Autoethnographic Inquiry**

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Coauthors: Indra Mani Shrestha

Abstract: As a teacher, the first author would teach mathematics without paying attention to each student individually. She would always try to help students improve their mathematics learning. But intelligent students would learn effectively, while weak and average students never improve their mathematics learning. After joining M. Ed. in Mathematics Education at Kathmandu University, the first author gradually encountered various innovative pedagogical approaches and learning theories and started to implement them in teaching mathematics. When she taught mathematics using Vygotsky's scaffolding approach, she realized that students learn best when divided into groups and encouraged to learn collaboratively. Moreover, in the collaborative learning setting, the intelligent students scaffold the weak students and learn from each other by sharing knowledge and skills. But the teacher should facilitate their learning by making them realize their strength instead of chanting their weaknesses. In this context, using autoethnography as a research methodology, the first author explores how Vygotsky's scaffolding approach helps students learn mathematics effectively through knowledge sharing based on her teaching experiences. The second author is a critical friend who helps her develop the conceptual framework of the paper and provides her with critical comments. The research study shows that Vygotsky's scaffolding approach helps students learn through knowledge sharing and develop collaboration, democratic, problem-solving, and critical-thinking skills. Besides the intelligent students, the weak students are also motivated to learn mathematics and gradually improve their mathematics learning.

ME10: **Monika Devkota**, Kathmandu University School of Education, Hattiban, Lalitpur, Nepal

Title: **Embodiment in Mathematics for Prioritizing Effective Teaching and Learning Environments**

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Coauthors: Netra Kumar Manandhar, Binod Prasad Pant

Abstract: There has been a debate of meaningful and constructive teaching and learning of mathematics. The debate incorporates the strategies that can be used to make mathematics knowledge live. Integrating embodiment in mathematics teaching and learning is one concept that places mathematics educators for effective teaching by solving issues such as mathematical anxiety, students' poor performance in mathematics assessment, and negative attitudes of students in mathematics. This research discusses how students learn to embody mathematical concepts when they solve mathematical problems. It highlights how understanding mathematical topics may be made simpler and how conceptual knowledge in mathematics can be developed more effectively. This research study's major goal is to examine how Embodiment in mathematics teaching improves students' meaningful learning of mathematics. The research used descriptive and argumentative approaches to collect data and interpret them by developing themes. This research also promotes the idea that embodiment is action-based and facilitates emotional connections between learners and their physical surroundings. The following are the primary justifications for why embodied cognition is advantageous for conceptual knowledge development: embodiment links the concrete and abstract; it reduces anxiety; it encourages active participation; and it helps with the improvement of communication and presentation abilities. Additionally, the student's interest in learning mathematics grows over time. The development of effective mathematics teaching and learning can benefit from embodiment. It serves as a link in the process of developing metacognitive awareness, allowing learners to study mathematics in a meaningful way.

ME11: **Prema Kumari Dhakal**, Mid-West University, Surkhet, Nepal

Title: **Challenges of Virtual Learning Environment in University Level Mathematics in Nepalese Context**

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Abstract: The aim of this study is to explore the challenges faced by the learners in virtual learning environment in Mathematics in university level. A qualitative case study was conducted in Nepal Open University. Altogether ten participants from the batch 2017-019 representing different districts were chosen purposively. In-depth interviews was the tools of data collection. Collected data was transcribed, coded and categorized to develop themes. The method of data analysis was thematic with quotations and quotes. The study revealed that virtual learning is an opportunity in higher education for job holders and married women as well as others who could not join face to face classes, although it has many challenges. The finding indicated that the learners have faced pedagogical challenges, technological challenges, challenges of time management, environmental challenges and psychological challenges while learning Mathematics virtually.

ME12: **Sandip Dhungana**, Kathmandu University, School of Education, Nepal

Title: **Students' Experience in Learning Trigonometry in High School Mathematics**

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Coauthors: Binod Prasad Pant, Niroj Dahal

Abstract:Trigonometry is an area of mathematics that students believe to be particularly difficult and abstract as compared with other areas of mathematics. It is introduced as the concept in the right-angled triangle from the basic level but the curriculum of Nepal introduced it from Grade IX onwards as a separate chapter which contributes nearly one-fourth of the total part in additional mathematics. This study aims to explore students' experiences in learning trigonometry. The data

are extracted from 12 Grade X students who had chosen additional mathematics in their optional courses and studied it in Grade IX also. Formal and informal interviews, diagnostic tests, and in-depth engagement with students in their classrooms were the major means of data extraction. In this sense, this study adopted phenomenology as a methodological stance. The data collected from the diagnostic test were analyzed and students' explanations of each question are discussed in this study. In doing so, this study concludes with some major findings. Students have difficulty learning trigonometry and have misconceptions about the basic concepts, which produces obstacles and errors in solving trigonometric problems. The possible errors are in procedural knowledge, conceptual knowledge, or link between these two types of knowledge. It is also found that a teacher needs to incorporate the learners' everyday experiences using teaching aids for meaningful learning and long-lasting knowledge. A teacher needs to be aware and responsible for students' activities inside the classroom. Healthy relationships between the teacher and the students can contribute significantly to learning trigonometry.

Keywords: Trigonometry, Learning Trigonometry, Students' Learning

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ME13: **Mira Gurung**, Kathmandu University, Kathmandu, Nepal

Title: **Teachers' Experiences of Using Feedback as an Assessment Approach to Students' Mathematics Learning: A Narrative Inquiry**

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Coauthors: Indra Mani Shrestha, Bal Chandra Luitel

Abstract: In the context of Nepali mathematics education, despite efforts to improve student achievement in mathematics from the school level to the policy level, recent results have not shown satisfactory mathematics achievement results. Many research studies have shown that among the assessment approaches, teachers' feedback can play a vital role in assessing students' mathematics learning. In this context, using narrative inquiry as a research methodology, Mira explored the experiences of three mathematics teachers on using feedback in assessing students' mathematics learning in the classrooms. Indra Mani and Bal Chandra assisted Mira in conceptualizing and developing the paper with their critical comments and feedback. The research showed that mathematics teachers frequently use classwork, quizzes, verbal probing questions, gesture observation, facial reading, and other assessment tools to determine students learning. This study demonstrated that although teachers may not possess a theoretical understanding of feedback, they employ a variety of feedback models, including feed-up, feedback, and feedforward. They are also aware of the significance of timely feedback, context-specific feedback, and understanding the learner before offering comments. This study also demonstrates that teachers do not use it consistently; rather, they offer it according to their comfort and expertise. If we can help teachers become more conscious of their positive or negative feedback practices and assist them in making them more systematic, teaching and learning will experience a sea change.

Key Words: Nepali mathematics education, Feedback as an assessment approach, narrative inquiry

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ME14: **Tas Bahadur Gurung**, Kathmandu University School of Education, Lalitpur, Nepal

Title: **A review of Nepali Mathematics Textbook from the Lens of Conceptual Knowledge**

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Coauthors: Binod Prasad Pant, Netra Kumar Manandhar

Abstract: Apart from Procedural Knowledge (PK) and procedural fluency, Conceptual Knowledge (CK) is one of the necessary knowledge areas required by students to accomplish proficiency in mathematics. However, in Nepal school education, regarding CK, the scenario is not satisfactory. Both teachers and students rely on textbooks for mathematical learning; consequently, influence learning outcomes. This literature-based study aims at analyzing four sections of Curriculum

Development Centre (CDC) mathematics textbooks: solved-example, exercise, project work, and mixed exercise, through the lens of CK. This study is limited to a set unit of grades (5-10) and in total 148 problems/tasks were analyzed. The two measures of explicit and implicit kind of CK were adopted to code problems/tasks included in four analyzed sections. However, during analyzing process, miscellaneous problems/tasks (e.g., project work) popped up which resemble both explicit and implicit kinds of CK. A comparative analysis based on textbook sections and grade levels was conducted. The study illustrated that miscellaneous and implicit kinds of CK appeared as the most (around) and the least (around) respectively. Furthermore, illustrated grades (8, 9, 10) and grades (5, 6, and 7) as those that emphasized more on miscellaneous and implicit kinds of CK respectively. This study is beneficial for every stakeholder devoted to educational reform, especially in mathematics, and has the desire to enrich mathematical learning through CK.

Keywords: CDC mathematics textbooks, conceptual knowledge, set unit, miscellaneous

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ME15: **Bir Kafle**, Purdue University Northwest, Hammond, IN, USA

Title: **Thinking With Algebra: A Project and Perspective**

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Abstract: Algebra is the gatekeeper to higher level mathematics and science courses (Domina, McEachin, Penner, & Penner, 2015; Long, Conger, & Iatarola, 2012). Without a rich understanding of algebra students will not be successful in STEM (RAND, Mathematics Study Panel, 2003). The Thinking with Algebra (TWA) Project aims to address a major need in the learning of algebra and the support of undergraduate instructors in the teaching of algebra.

In this talk, we will share insights and characteristics of TWA, a National Science Foundation Project. The focus will be on the value of using this curriculum when working specifically with students who have already taken Algebra I and Algebra II in High School but are not yet prepared for college algebra or precalculus. This curriculum is specifically designed for these students who place below the level of college algebra when they enter college. (Joint work with D. Feikes, W. Walker, and N. McGathey).

ME16: **Lokendra Karki**, Kathmandu University, Lalitpur, Nepal

Title: **How Can We Improve Students Learning in the Basic Concepts of Trigonometry in School Mathematics? An Action Research Study**

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Coauthors: Niroj Dahal

Abstract: Guided by the questions–what strategies can be implemented to enhance students' fundamental concepts of trigonometry in school mathematics? and what are the benefits of our collaborative effort with the students to motivate them to learn the fundamental concepts of trigonometry? This action research sought to report the basic tents of actions research planning, acting, observing, and reflecting. As learning trigonometry seems a bit tough for students. They find it tough due to the transference of experience of seniors and the number of formulas used in trigonometry. Apart from this, the problems related to trigonometry also seem tough for students. We have performed this action research work to overcome the issues students encounter in while teaching and learning trigonometry. The methods and styles that we use are found to be fruitful for the students in the learning of trigonometry. We used activity-based learning along with storytelling and collaborative learning too for teaching the learning process for the contents of trigonometry. We collect the data based on the performing activities related to Pythagoras' theorem, trigonometric ratios, and height and distance. The study showed that mathematics teaching by using activity-based learning, storytelling, and collaborative method has brought a change in the learning of the students far better in trigonometry in comparison to traditional ways of teaching and learning fundamental concepts of trigonometry. This study shall be helpful for the mathematics community to challenge the traditional ways of teaching and learning concepts of trigonometry.

ME17: **Sarita Khadka**, Kathmandu University School of Education, Lalitput, Nepal

Title: **Exploring Pedagogical Approaches to Developing Numeracy Skills of Students with the ASD: An Autoethnographic Inquiry**

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Coauthors: Indra Mani Shrestha, Binod Prasad Pant

Abstract: In the context of Nepal, students with autism in the Early Childhood Development (ECD) level have difficulties in developing their numeracy skills in the regular classroom settings. In this context, many research studies have shown that teacher are usually unable to recognize students with learning disabilities such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), etc. As a result, they are treated as normal students and gradually suffer in learning. As an expert of special education, Sarita have been working as a teacher and a teacher-educator in the field of special education in schools. She has been teaching the ECD level students the numeracy using various pedagogical approaches and educated the ECD level teachers about ASD. Using autoethnography as a research methodology, Sarita explored her experiences of teaching the ASD students the numeracy and educating teachers about the ASD. Indra Mani and Binod assisted her in conceptualizing and developing the paper through their critical comments and suggestions. The research study showed that applying arts-based pedagogy, using picture-cue cards, hands-on materials, clay and dough activities are useful to support students with the ASD who are at risk for mathematical difficulties and therefore more effective in teaching the ECD level students with the ASD the abstract concepts of numeracy such as number recognition, counting, number patterns, number comparison, number operations, and estimation. The role of individualized support to a child with the ASD was the most supportive approach to developing numeracy skills the ASD students. The study also suggested that to address the diverse needs of a child and to inculcate the numeracy skills, teachers must understand their students' strengths and weakness and design the activities accordingly. The study also suggested the collaboration between teachers and parents to ensure the students' learning.

Keywords: ASD students, ECD, arts-based pedagogy, individual support , teachers-parents collaboration

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ME18: **Deepika Kutu**, Kathmandu University School of Education, Lalitpur, Nepal

Title: **Ethnomathematics in Newari Cultural Artefacts and Practices as an Innovative Pedagogical Approach: Autoethnographic Reflections**

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Coauthors: Indra Mani Shrestha, Niroj Dahal

Abstract: Being a mathematics teacher from the Newar community, Deepika grew up with many cultural artifacts and practices. When she was admitted to a nearby school, she started to experience different worlds, and gradually her learning paradigm shifted to global learning practices. Now she realized how the Nepali education system had snatched her home-grown mathematical practices in the name of globalization of education. Though many efforts have been made in Nepali education by prioritizing the local curriculum, she as an institutional mathematics teacher could not find inclusive mathematical practices in the classroom. Nevertheless, after joining M. Ed. in Mathematics Education at Kathmandu University, she encountered ethnomathematics and realized she could connect her cultural practices to teaching mathematics. Eventually, she started to bring her Newari cultural artifacts and practices in teaching mathematics in the classroom. She developed her Newari cultural artifacts and practices as an innovative pedagogical approach, which helped her motivate students from diverse cultural backgrounds to connect mathematics with their cultural artefacts and practices. In this context, using autoethnography as a research methodology, this paper explores how Deepika challenged the global mathematical practices through ethnomathematics in Newari cultural artefacts and practices, how she used it to develop students' conceptual

understanding of mathematics, and how she motivated her students to bring their cultural artifacts and practices in the classroom to conceptualize abstract mathematics. Indra Mani and Niroj helped her develop the paper from the conceptualization phase to the developmental phase through their critical perspectives. The research showed that ethnomathematics in Newari cultural artifacts and practices became an innovative pedagogical approach to teaching mathematics in the first Deepika's professional journey. It helped her students develop their conceptual understanding of mathematics, bring their cultural artifacts and practices into the classroom to conceptualize abstract mathematics, solve real-world problems, learn mathematics through ethnomodeling, and challenge the global mathematical practices through the ethnomathematics in their cultural artifacts and practices as an innovative learning method.

Keywords: ethnomathematics, Newari cultural artefacts, and practices, students' cultural artefacts and practices, ethnomodeling

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ME19: **Basanta Raj Lamichhane**, Saptagandaki Multiple Campus, Bharatpur, Nepal

Title: **A Critical Rendition to the Development of Mathematics Education in Nepal: An Anticolonial Proposal**

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Coauthors: Bal Chandra Luitel

Abstract: The history of mathematics education in Nepal had not been explored until the end of the twentieth century. After exploration, it was not included in mathematics curricula due to the invasion of western modern mathematics since 1853. It is quite disheartening that the students who graduated from the university remained ignorant about Nepal's mathematics education history. Against this background, the central purpose of this argumentative paper is to explore oppressive forces behind colonial meddling and envisage an alternative anticolonial proposal of the history of mathematics education. By using anticolonial critical lens as a referent, I offer four phases-classical humanists, multi-epistemic, neo-colonial, and critical discourse – by challenging the linear, neutral, and informative ways of reading and writing history. These phases incorporate Nepal's rich socio-cultural, historical, and political landscape, contribute to creating new discourses and perspectives in mathematics education, and thus reconceptualize a history of mathematics education as a means of transformation.

Keywords: History of Mathematics Education; Classical humanist Phase; Multi-epistemic Phase; Neo-colonial Phase; Critical Discourse Phase.

ME20: **Manoj Lamichhane**, Florida Polytechnic University, Lakeland, USA

Title: **Implementation of Team Based Inquiry Learning (TBIL) in Calculus Classes at Florida Polytechnic University**

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Abstract: Team-Based Inquiry Learning (TBIL) is an innovative teaching strategy emphasizing the process of personal discovery by the learners working in a group. This method engages students in mathematics by combining Inquiry-Based Learning and Team-Based Learning. This talk focuses on my experience incorporating TBIL in calculus classes in Fall 2022, and I further talk about TBIL preparation, supporting materials, and students' feedback.

ME21: **Netra Kumar Manandhar**, Kathmandu University School of Education, Lalitpur, Nepal

Title: **Artificial Intelligence in Mathematics Education (AIMED): How is Constructivist Learning Possible?**

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Abstract:Every change in the world has affected the ways of learning mathematics and transferring mathematical skills from one person to another. Based on these changes, people are learning to adapt these ways to develop mathematics knowledge and skills. The present context of rapid development in technology, especially artificial intelligence, has created a space for thinking and designing new ways of mathematics teaching and learning. In addition, the recent release of GPT-4 artificial intelligence model and machine learning centers people in integrating AI into mathematics education. The research in AIED (Artificial Intelligence in Education) and AIMED puts forward the facts that mathematics educators must think about AI-integrated ways of educating students. However, the major issues of integrating AI-powered technology in mathematics education are people's mindset regarding the nature of mathematics knowledge and technology, lack of AI education and skills in using these technologies, and other digital divides. There is a need for knowledge and skills of how the interplay between constructivism's ways of education and AI can be crucial to learn mathematics effectively and efficiently. In this context, this paper presentation aims at exploring how AIMED (Artificial Intelligence in Mathematics Education) can change the ways of educating children in mathematics, which eventually helps learners to better construct mathematical knowledge and skills. The paper addresses the need to integrate artificial intelligence to use AI for personalized learning, AI-based tutoring system, assessment, etc. The paper examines the effectiveness of recently developed AI-powered tools and presents how mathematical skills can be enhanced by integrating these new ways of learning. The paper uses an explorative and argumentative method to present data. Due to the rapid development in AI and the massive use of AI-powered technologies, people will find this paper a worthwhile product to redesign their mathematics educational programs based on AI-powered technologies.

Keywords: Artificial Intelligence, AIMED, Constructivism

ME22: **Kedar Nepal**, Mercer University, Macon, USA

Title: **International Mathematics Faculties in the USA: Changes in Instructional Practices and Associated Factors**

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Coauthors: Deepak Basyal, Bhesh Mainali

Abstract: Mathematics departments at higher education institutions in the USA employ a large number of international faculties. Most of these international faculties come to the USA as graduate teaching assistants and eventually choose to become mathematics instructors at colleges and universities in the USA. This qualitative case study investigated instructional practices employed by Nepalese international mathematics faculties while teaching undergraduate mathematics courses in the USA. The data was collected using semi-structured interviews with six Nepalese mathematics faculties, who were selected using a convenient sampling method. We used open coding techniques to analyze transcribed interviews to identify instructional approaches adopted by these instructors and associated factors related to their instructional practices. The data analysis showed that the participants changed their instructional practices primarily from teacher-centered to student-centered approaches while teaching in the USA. The participants attributed the changes in their teaching practices to their own teaching experiences, professional development opportunities, instructional freedom, cultural and systematic factors, and availability of resources. Implication of these findings in relation to designing professional development programs for international graduate teaching assistants and full-time instructors in the USA will be discussed. As the participants have educational and teaching experiences both in their home country Nepal and the USA, we will also discuss how mathematics instruction in higher education in Nepal can be improved by drawing upon their experiences and viewpoints.

ME23: **Binod Prasad Pant**, Kathmandu University, School of Education, Lalitpur, Nepal

Title: **Transformative STEAM Education as a framework for empowerment in mathematical learning: A case of a public school in Nepal**

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Coauthors: Bal Chandra Luitel

Abstract: Elsewhere (Luitel, 2013, 2019; Pant, 2017, 2029), we have argued for the development of culturally inclusive and contextualized mathematics education as a recourse to disengaged and decontextualized educational processes in mathematics education experienced by Nepali students, teachers, and teacher educators. With such an orientation, our research program at Kathmandu University School of Education focused on the notion of research as/for professional development via multi-epistemic critical reflective inquiries into the practices of researchers as mathematics teachers, teacher educators, curriculum developers and educational researchers (Taylor, Taylor, & Luitel, 2012). One of many features of our research program is to incorporate critical epistemologies in examining the practitioner-researchers' cherished beliefs, values and assumptions, thereby preparing them to address the problem of disengaged educational processes in their personal and professional contexts. This paper entails the first author's ongoing PhD research study working with basic-level school teachers via participatory action research design to help teachers develop rich tasks through the framework of transformative STEAM Education, a multidisciplinary approach to constructing pedagogical possibilities via twenty-first-century skills as crosscutting curricular outcomes.

The presentation begins with the need to shift the conventional mathematics education program in the context of the global crisis. The discussion of different forms of STEAM education is done by introducing the paradigm of transformative learning as an extension of critical socio-political action in mathematics pedagogy, followed by the articulation of participatory action research as transformative epistemology, which is needed to plan and intervene in empowering pedagogical processes in mathematics. The outcomes of the research shall also be discussed with challenges and ways of addressing them. Finally, the chapter/presentation concludes how teachers and teacher educators apply similar epistemology and pedagogy in their classrooms.

ME24: **Ram Krishna Panthi**, Tribhuvan University, Mahendra Ratna Campus, Kathmandu, Nepal

Title: **Mathematics and Mathematics Education: Bridging the Gap between Content and Pedagogy**

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Coauthors: Shashidhar Belbase, Bed Raj Acharya, Mukunda Prakash Kshetree, Bishnu Khanal

Abstract: There is an ongoing debate about how to teach and learn mathematics in an effective way. However, there is no consensus about how this effective way may look like. Mathematicians and mathematics educators may have different priorities about what to teach, how to teach, when to teach, and why to teach mathematics. These differences might have caused a gap between the content and pedagogy of mathematics to be included and practiced in school mathematics. This paper focuses on the paradigmatic possibilities of border crossing between mathematics and mathematics education in order to meet the epistemic and methodological gaps between mathematics and mathematics education and foster meaningful curriculum, teaching, learning, and assessment practices in school mathematics. We present the epistemological and pedagogical implications of the new paradigmatic possibilities.

Keywords: mathematics, mathematics education, epistemic gap, methodological gap, paradigmatic possibilities, school mathematics.

ME25: **Kharika Parajuli**, Tribhuvan University, Kathmandu, Nepal

Title: **Learning School Geometry Through Rekhis of Brahmin's Cultural**

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Abstract: Brahmins belong to a religious cultural group. Some of the people of this group perform religious rituals. The purpose of this paper is to explore to uncover geometry concepts and shapes from the Brahmin's rekhi available in the Mandap during puja. This is a qualitative research study

with an explorative ethnographic approach. The methodological procedure included participant observation, group discussion, notes taken from the field and personal reflection. The information was analyzed by connecting with students' generated field experience and perception over the rekhi drawn in the Mandap. The major themes that appeared were symmetry and reflection; Rekhi as a source of learning geometry and as a possible learning exchange; and sharing through cultural practice. The study showed that rekhi is a source of learning geometry and sharing the cultural practice with the other groups of people. The study also showed that school geometry provides the knowledge of properties (i.e. parallelogram, congruent triangles, types of triangles, intersecting lines, vertically opposite angles, quadrilaterals, symmetry and reflection). These properties are available in the rekhis of Brahmin's cultural practice. Students obtained this knowledge by redrawing, observing, adding lines, imagination, estimating and logically braiding with the rekhi patterns. They also came up with the knowledge that geometry can be learnt in the non-Brahmin's rites and rituals. The findings of the study can be helpful to teachers, and students to learn and teach geometry by connecting their experience with their own rites, rituals, arts and artifacts of the non-Brahmin communities.

Keywords: Brahmin cultural, Rekhi, Ethnomathematics, Mathematics learning, School geometry

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ME26: **Susmita Pathak**, Sanskriti International School, kathmandu, Nepal

Title: **Detrimental Factors for Poor Skills in Geometry : A Case Study**

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Abstract: In my teaching experience, some of the students have poor achievement in mathematics among other subjects. In recent times, students are struggling in mathematics learning in general and geometry in particular. Subscribing case study research method-this study aims to identify the detrimental factors for poor skills of mathematics students and explore the strategies used by teachers for promoting skills in geometry. Six low achievers, two teachers, and two parents were purposively chosen for the study. Likewise, one principal, one department head, and one stakeholder were selected. With my subjects and using the teacher's classroom observation notes, I conducted semi-structured interviews among the research participants. I transcribed and translated audio records into English verbatim. Making connections with the literature, I made narratives and came up with the study's themes and subthemes.Thematic analysis was used in the study. Open ended questions format were the tool of the study. I came across four themes that were related to factors which were less positive for having poor math skills, including the students' generalisation abilities, their lack of interest in learning new math concepts, the lack of qualified teachers, and the use of inadequate teaching resources. Emphasis on low achievers in mathematics learning, contextual teaching and learning, an interactive method of teaching, and differentiated instruction to raise students' achievement levels are among the themes I discovered to be associated with the strategies employed by the teachers.

Key Words: Detrimental factors, insufficient skills, differentiated instruction and students achievement

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ME27: **Tara Paudel**, Kathmandu University, Dhulikhel, Nepal

Title: **STEAM (Science, Technology, Engineering, Arts, and Mathematics) Education in Nepal**

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Coauthors: Balchandra Luitel

Abstract: The paper explores a fresh concept of an integrated approach known as STEAM (science, technology, engineering, arts, and mathematics) education in the context of Nepal. This paper is prepared with the help of different pieces of literature as well as classroom observation. STEAM is the heart of the whole educational reform of the 21st century and a developing educational model in the in/formal education field, which integrates science, technology, engineering, mathematics,

and arts to form an approach. It helps to produce competent human resources to meet 21st-century skills such as critical thinking, problem-solving, creativity, innovation, communication, collaboration, technology skills, digital literacy, and entrepreneurship. In this context, the purpose of this paper is to explore the importance and integrated concept of STEAM education in Nepal. It unites different disciplines, so they can connect to make teaching and learning realistic. It is more engaged in teaching-learning where learners are active cognitive beings and teachers are designers and environment setters. If the nation wishes for the successful outcome of STEAM education, a visionary plan and way forward need to be adopted.

ME28: **David Plaxco**, Clayton State University, Morrow, GA, USA

Title: **An Inquiry-Oriented Task Sequence for Teaching Determinants**

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Coauthors: Megan Wawro, Matthew Mauntel

Abstract: Drawing on the curriculum design theory of Realistic Mathematics Education [RME], we developed an Inquiry-Oriented task sequence for teaching determinants as part of a broader set of curricular materials: the Inquiry-Oriented Linear Algebra [IOLA] curriculum. Designed to take place after a unit on Matrix Transformations, the Determinants unit supports students in the guided reinvention of the notion of determinant as a measure of how matrix transformations distort space, specifically, as a signed multiplicative scaling factor of area (for a 2×2 matrix) or volume (for a 3×3 matrix) that extends to larger $n \times n$ matrices.

The task sequence begins with students developing a geometric sense of the determinant in terms of a signed ratio of the areas of a pre-image and image objects transformed under a linear transformation. Students then use this definition to derive the 2×2 determinant formula and then generalize a reciprocal relationship between a matrix and its inverse. Finally, students explore 2D and 3D applets to generalize toward core theorems related to the determinant involving linear dependence and switching/scaling columns. We will present the task sequence as well as some student results from the sequence.

ME29: **Krishna Pokharel**, University of North Georgia, Watkinsville, USA

Title: **Are Students' Higher Order Thinking Skills being Assessed in the High School Mathematics Board Exams of Nepal?**

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Coauthors: Kedar Nepal, Deepak Basyal

Abstract: Mathematics curricula of many nations emphasize developing students' higher order thinking skills (HOTS). Such skills go beyond just learning basic facts and following memorized procedures but help students think critically and enable them to solve real-world problems. Assessment practices must also align with the curricular goals because assessment tools, especially exams, are indicators of what is valued and have the potential "washback effect" on the teaching and learning of mathematics. The purpose of this study is to investigate how HOTS are being assessed in the board exams of the high school mathematics courses in Nepal. Using Bloom's taxonomy as a framework to categorize exam questions, we analyzed mathematics board exams of grades XI and XII from the last fifteen years. Preliminary results show that very few HOTS questions were included in the exams, and an overwhelming majority of the problems just tested students' lower order thinking skills (LOTS). Results also show that most of the exam questions can be solved by mimicking the procedures and practicing the textbook problems and those problems that have appeared in previous board exams. We will discuss the significance of these findings in relation to the teaching and learning of high school mathematics in Nepal.

ME30: **Madan Rijal**, Kathmandu University, Lalitpur, Nepal

Title: **Integradted STEAM Approach for Meaningful Mathematics Teaching and Learning**

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Abstract: The synergic approach of STEM + Arts has been unboxing the new perspective as well as dimensions in the educational field. It has accepted the learners as an active agents of societal change through the interrelated processes of being, knowing, and doing by keeping them at the center of the learning process. This integrated STEAM approach helpful to understand and accept the individual difference of the learners and their inert abilities. This has opened up the idea of different alternative approaches of learning for the learners rather than just being a passive receptors and focused on rote memorization and rigorous practices of routine algorithmic textual problems. And eventually, it has brought us to focus our concentration on the adapting constructive assessment procedure out from the rigid perimeter of assessment of learning (summative) to assessment for learning (formative). Moreover, as STEM education helped us to understand the concepts and principles behind certain phenomena and empowered us to develop various skills of inquiry and innovation through integrated approach of the different disciplines namely – Science, Technology, Engineering and Mathematics, the addition of Arts has given us a new effective direction and dimension. It has been encouraging educators and learners on developing different transdisciplinary abilities which are very essential for engaging in building a productive, sustainable, and just society.

Keywords: STEAM, assessment, formative, summative, transdisciplinary abilities.

ME31: **Indra Mani Shrestha**, Kathmandu University School of Education, Lalitpur, Nepal

Title: **Connecting School Mathematics with Agriculture and Entrepreneurship Using Transformative STEAM Education Approaches**

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Coauthors: Bal Chandra Luitel

Abstract: Several efforts have been made to transform Mathematics Education in Nepal from the decontextualized education approach to the contextualized education approaches by incorporating an integrated curriculum in Grades 1-3, local curriculum, and STEAM Education as a pedagogical approach in school education. School education needs to be promoted to produce human resources who are skillful in the context of Nepal. The first author, a Ph. D. researcher, recently conducted the first intervention in a community school at Dullu Municipality, Dailekh, Karnali Province. The intervention helped explore the possibilities and challenges in implementing Transformative STEAM Education approaches (i.e., critical, integrated, and contextualized pedagogical processes) to connect school education with Agriculture and entrepreneurship and establish "STEAM Green School" (integrated/multidisciplinary approaches for promoting sustainable development) so that the research study can contribute to achieving some of the United Nations' 17 Sustainable Development Goals (SDGs). The intervention report explored that the school has already started connecting school education with agriculture and entrepreneurship such as mushroom farming, seasonal vegetable farming, and buffalo farming in an unorganized form while there is a forest nearby the school where the medicinal herbs can be grown. Besides, most of the male parents in the community have abandoned the village to either cities or abroad, especially India for earning. Therefore, under the supervision of the second author, the first author has started his Ph.D. research study to explore the roles of science and mathematics education in the mentioned areas using Participatory Action Research (PAR) as a research methodology. However, in this paper, we only present the possibilities and challenges of connecting Mathematics with Agriculture and Entrepreneurship and establishing "STEAM Green School" using transformative STEAM education approaches based on the first intervention report.

ME32: **Uttam Shrestha**, Kathmandu University School of Education, Banepa, Nepal

Title: **Secondary Level Mathematics Teachers' Perception onAssessment: A Narrative Inquiry**

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Coauthors: Indra Mani Shrestha, Bharat Prasad Neupane

Abstract: Most students take the assessment in mathematics teaching and learning as a liability because of the inappropriate pedagogical approaches in the context of Nepal. They think mathematics learning is about scoring good grades in the examinations to satisfy their parents. However, many research studies have shown that the inclusion of different assessment strategies, such as formative and summative assessments, in teaching and learning mathematics motivates students to learn mathematics meaningfully. In this context, we conducted an in-depth interview with two secondary level mathematics teachers to explore their perceptions of assessment in mathematics teaching and learning. Analysis of theirnarratives showed that an appropriate assessment strategy motivated students to learn mathematics meaningfully, helpedthem concentrate on learning and increase their thinking skills. They developed confidence in learning mathematics as the need-based assessment helped them conceptualizemathematics. They actively engaged themselves in learning mathematics in the classroom. They built up their confidence as proper assessment helped them develop critical thinking skills, which in turn, developed skills to solve problemstactfully and score better grades in examinations. Among the assessment strategies, the teachers asserted that test papers and worksheets are the most effective tools for assessing students' mathematics learning.

Keywords: Perceptions, summative assessment, formative assessment, mathematics teaching and learning

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ME33: **Daya Simkhada**, Kathmandu University, School of Education, Lalitpur, Nepal

Title: **My Experiences as a Mathematics Text Book Writer for School Education of Nepal: An Inclination to Progressive Thoughts and Actions**

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Abstract: As a mathematics textbook writer for school education (grade 1 to 10) in Nepal, my experiences have been shaped by a deep-seated inclination towards progressive thoughts and actions. Through my work, I have aimed to create educational materials that not only impart knowledge but also inspire critical thinking and problem-solving skills in students. Arriving at this stage of gathering two decades of professional experiences, my approach to writing textbooks has been informed by a commitment to making math education accessible and engaging for all students, regardless of their backgrounds or abilities. Despite many structural, functional and policy-level challenges, I have worked tirelessly to create clear and concise explanations, as well as exercises and examples that are relevant and relatable. In addition to focusing on content, I have also strived to incorporate innovative teaching methods and technologies into my textbooks. From interactive online resources to collaborative learning exercises, I have sought to provide students with a range of tools and techniques that can help them better understand and appreciate the beauty of mathematics. To this reference, the purpose of this presentation is to showcase my experiences as a mathematics textbook writer and share with larger audiences the importance of continuous learning and adaptation in the face of changing educational landscapes.

Key words: textbook writer, progressive thoughts and actions, continuous learning and adaptation

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ME34: **Mohan Thapa**, University of Wisconsin- WC, USA

Title: **Examining Opportunities to Learn Limit in Calculus Textbooks in Nepal**

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Coauthors: Deepak Basyal

Abstract: This study examines mathematics textbooks to explore opportunities to learn the concept of limit. Three calculus textbooks published by various publishers in Nepal make our sample. We used APOS theory as a theoretical framework to code definitions, worked-out examples, and exercise problems in the limit chapters of our sample textbooks according to Genetic Decomposition of Limit (Cottrill et al., 1996, pp 177-178). Results show most problems in calculus textbooks in Nepal are in step 1 of the Decomposition of Limit process, in which students only evaluate functions at a point. In conclusion, these textbooks provide limited opportunities to use informal thinking to understand the infinite process of the concept of limit. Implications of the study in regard to teaching and learning the concept of the limit will be discussed.

ME35: **Hari Narayan Upadhyaya**, Former Principal at Scholars Home Academy, Kathmandu, Nepal

Title: **Identifying Symmetric Paper Folding Activities in School Mathematics**

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Abstract: The concept of symmetry is an old as the origin of the earth, the planets and the solar system as a whole where the sun and other planets are perfectly symmetric in their axes and they follow the symmetric rotation in their axes, and the path they revolve around the sun are mostly the elliptical paths symmetric in their major and minor axes. With these glimpses of historical perspectives of symmetry in human activities, school mathematics curriculum of the world in general and in this context, particularly schools' symmetries of different kinds have been introduced with primary focus of the topics through primary to upper grades of high school curriculum and this presentation focuses on symmetric paper folding ideas relating with the mathematical concepts incorporated in the school mathematics curriculum of Nepal. Here are a few activities in paper folding relating the symmetries and mathematical concepts associated with them.

Numerical Analysis, Scientific Computation, and Optimization (NA)

NA1: **Ilyani Abdullah**, Universiti Malaysia Terengganu, Kuala Nerus, Malaysia

Title: **Mathematical modeling of water flow dynamics in a river channel**

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Coauthors: Shohboz Juraev, Rakhmatillo Aloev

Abstract: The Saint-Venant equations are a widely studied set of differential equations used as a hydrodynamic model. While several approximate methods exist for solving these equations, this study proposes a new approach using neural networks. Specifically, we describe a system that employs neural networks to solve complex problems involving Saint-Venant equations. Our results demonstrate the potential effectiveness of using neural networks for solving mixed problems of differential equations. Due to the inherent stability of neural models against errors in input data, neural networks may provide a promising alternative to traditional approximation methods for solving differential equations.

NA2: **Bishwa Raj Adhikari**, Tribhuvan University, Kathmandu, Nepal

Title: **An Insight on Multicriteria Optimization**

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Coauthors: Tanka Nath Dhamala, Urmila Pyakurel

Abstract: Real design problems frequently involve more than one objective. Practically these objective functions are competing and contradicting. A multicriteria optimization problem is one where it is worthy to optimize these conflicting objectives. While solving such problems, with or without the presence of constraints, they give rise to a set of trade-off optimal solutions, known as Pareto-optimal solutions. A solution is pareto-optimal when one of the objectives improves its quality that affects adversely to another objective. Finding the solution to such multiobjective problem, it requires a multicriteria workflow: design an optimization model with multicriteria, find out the non-dominated set, and allow the created design to concern authority for examination. The concept of Pareto optimality has played an important role in the solution process that explicitly recognize the conflicting nature of optimal solutions, in terms of balancing different objectives. Intensity modulated radiotherapy and volumetric arc therapy that are formulated as multicriteria optimization problem having high clinical quality. Out of the methods striving for pareto-optimality: weighted sum, compromising programming, epsilon-constraint method and genetic algorithms are prominent. Since multicriteria optimization generally yields an infinite family of optimals, our study on it is to develop algorithms on plan optimization and the reduction of computational complexity in the navigation of pareto-optimal solution that helps in decision-making criteria.

Keywords: Multicriteria, Trade-off, Pareto-optimal

NA3: **Iswar Mani Adhikari**, Prithvi Narayan Campus, TU, Pokhara, Nepal

Title: **Asymmetrical Transit Times in an Integrated Evacuation Network Topology.**

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Coauthor: Ram Chandra Dhungana

Abstract: We are under the threat of natural or human-created disasters. Disasters are unavoidable and are mostly uncertain to happen. If this occurs, the situation becomes vulnerable and affects badly the traffic systems. The optimal use of the vehicles and their assignments to the appropriate shelters from the disastrous zones are highly complicated in such situations. The efficiency and

effectiveness of evacuation planning can be achieved by the appropriate assignment of the transit vehicles during disaster operations. Evacuation planning problems are handled with different perspectives, namely, the transit-based, car-based, and pedestrian movements depending upon the evacuation scenarios and the nature of the evacuation network. In a transit-based system, the effectiveness depends upon the evacuee arrival patterns at the pickup locations and their appropriate assignment to transit vehicles in the available evacuation network. Mostly, the evacuation network is considered to be with symmetric transit times but is rarely in a real-life situation. This research work deals with the transit-based evacuation system in the network with asymmetric transit times, and their solution strategies.

NA4: **Ram Adhikari**, Rogers State University, Claremore, USA

Title: **Numerical Stability Analysis of a Weak Simpson Method Based on Simpson Rule for a Class of Stochastic Differential Equations**

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Abstract: A weak Simpson method has order of weak convergence one in general and has order of weak convergence three under certain additional assumptions. The proposed method has the potential to overcome some of the numerical instabilities that are often experienced when using explicit Euler method. This work aims to determine the mean-square stability region of the weak Simpson method for linear stochastic differential equations with multiplicative noises. In this work, a mean-square stability region of the weak Simpson scheme is identified, and step-sizes for the numerical method where errors propagation are under control in a well-defined sense are given. The main results are illustrated with numerical examples.

NA5: **Elisabete Alberdi**, University of the Basque Country UPV/EHU, Bilbao, Spain

Title: **Implicit symplectic methods for high precision numerical integration of the Solar System**

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Coauthors: Mikel Antoñana, Joseba Makazaga, Ander Murua

Abstract:We present FCIRK16, a 16th-order implicit symplectic integrator for long-term high-precision Solar System simulations. Our integrator takes advantage of the near-Keplerian motion of the planets around the Sun by alternating Keplerian motions with corrections accounting for the planetary interactions. Compared to other symplectic integrators (the Wisdom and Holman map and its higher-order generalizations) that also take advantage of the hierarchical nature of the motion of the planets around the central star, our methods require solving implicit equations at each time-step. We claim that, despite this disadvantage, FCIRK16 is more efficient than explicit symplectic integrators for high-precision simulations thanks to: (i) its high order of precision, (ii) its easy parallelization, and (iii) its efficient mixed-precision implementation which reduces the effect of roundoff errors. In addition, unlike typical explicit symplectic integrators for near-Keplerian problems, FCIRK16 is able to integrate problems with arbitrary perturbations (non-necessarily split as a sum of integrable parts). We present a novel analysis of the effect of close encounters in the leading term of the local discretization errors of our integrator. Based on that analysis, a mechanism to detect and refine integration steps that involve close encounters is incorporated in our code. That mechanism allows FCIRK16 to accurately resolve close encounters of arbitrary bodies. We illustrate our treatment of close encounters with the application of FCIRK16 to a point-mass Newtonian 15-body model of the Solar System (with the Sun, the eight planets, Pluto, and five main asteroids) and a 16-body model treating the Moon as a separate body. We also present some numerical comparisons of FCIRK16 with a state-of-the-art high-order explicit symplectic scheme for 16-body model that demonstrate the superiority of our integrator when very high precision is required.

NA6: **Suman Balasubramanian**, DePauw University, Greencastle, IN, USA

Title: **Centrality Measures in Transportation Networks**

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Abstract: Networks model important aspects of our daily lives regarding distribution networks, friendships and connections, interactions on social media platforms, marketing, electricity, etc. In this research, we present a network model that is used to calculate the optimization of the flow of resources and the cost of shipping the resources within a transportation system. In addition, we also measure the relative importance of the nodes in the system using various centrality measures.

This is joint work with William Wood.

NA7: **Hum Nath Bhandari**, Roger Williams University, Bristol, USA

Title: **Machine Learning Applications in Computer Vision and Sequential Data Modeling**

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Coauthors: Binod Rimal, Ramchandra Rimal, Nawa Raj Pokhrel, Keshab Raj Dahal

Abstract: The recent advancement in machine learning techniques, availability of the large scale data due the widespread digitalization, and the increased computational capabilities have opened the door for researchers to develop sophisticated methods for solving complex science, engineering, and business problems. In this study, we provide a broader perspectives on utilizing some of the key machine learning architectures for solving problems, particularly in the area of computer vision and sequential data modeling. Theoretical aspects of key model architectures will be discussed and their implementation frameworks will be illustrated using various case studies.

NA8: **Phanindra Prasad Bhandari**, Khwopa Engineering College, Bhaktapur, Nepal

Title: **Maximum Flow on Lossy-network with Flow-dependent Loss Factors**

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Coauthors: Shree Ram Khadka

Abstract: In this paper, we study a maximum flow problem on a lossy-network with flow-dependent loss factors. The problem has application in efficient logistic supply with possible loss, theft, or customs tariff during supply. We propose a polynomial-time algorithm to solve the problem for the general network. Moreover, we extend the problem to networks with intermediate storage capabilities at vertices of given priorities, which has also been solved in polynomial time.

Keywords: Lossy-network, Flow-dependent, Logistic supply, Network flows, Lexicographically maximum flows

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NA9: **Tek Bahadur Budhathoki**, Department of Appied Sciences, Thapathali Campus, Tribhuvan University, Kathmandu, Nepal

Title: **Analysis of a Coupled Model for Mixture Mass Flow**

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Coauthors: Puskar Raj Pokhrel

Abstract: Mass transportation processes such as landslides, debris flows, and flash floods are devastating natural hazards that can be modeled using partial differential equations. To create an efficient simulation, an appropriate description of these types of flows is needed. Pokhrel et al. (2019) developed a physicalmathematical model consisting of highly non-linear and coupled partial differential equations for mixture mass flow that captures the physics of mixture flow dynamics.

In this presentation, we propose a coupling strategy for numerical models that combines the full-dimensional and depth-averaged model equations for mixture mass flows. Our technique uses full-dimensional simulation in regions with large gradients of field variables and depth-averaged model equations for relatively smooth flows. This coupling strategy preserves the basic physics of the flow while ensuring fast and economic numerical computation. Additionally, simulations based on the new model are significantly faster than full two-phase simulations. We discuss and analyze the parameters used in the model and present new model structures for full-dimensional mixture flows and depth-averaged mixture models for channel flows, including domain decompositions, coupling across interfaces, and boundary conditions for velocities and pressure at the free and basal surfaces.

Keywords: Physical-mathematical model, Partial differential equations, Multiscale modeling, Depth-averaged model.

NA10: **Prem Bahadur Chand**, National Academy of Science and Technology, Dhangadhi, Kailali, Nepal

Title: **Optimal Methods For Solving Nonlinear Equations: Design and Dynamics**

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Abstract: In this work, using the idea of weight functions on the third-order Potra-Pták method, we present an optimal fourth-order method and a family of optimal eighth-order methods. These methods are tested on some applied problems of engineering and sciences. The results are compared with some known methods. Furthermore, applying these methods to quadratic and cubic polynomials, their stability is analyzed by means of their basins of attraction.

NA11: **Bishnu Prasad Chapagai**, Dhaulagiri Multiple Campus, Baglung, Nepal

Title: **Network Interdiction under Arc Reversal**

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Coauthors: Phanindra Prasad Bhandari, Shree Ram Khadka

Abstract: Unwanted disturbance on the pre-scheduled flow plan over the network is the network interdiction. A problem related to it is the network interdiction problem, which has a wide range of real-world applications, including transportation problems and logistics supply problems. The problem can also be applied to model an evacuation. The network contraflow approach, which allows the arc reversal capability in the network, is a widely accepted tool for efficient evacuation. In this paper, we study a network interdiction problem with arc destruction over the network under arc reversal capability.

Keywords: Network flow, Network interdiction, Arc Reversal, Evacuation

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NA12: **Prakriti Dhakal**, Advanced College of Engineering and Management, Kathmandu, Nepal

Title: **Overview of Disease Prediction through Machine Learning Algorithms**

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Abstract: The huge amount of data produced from health sector can extract information for facilitating healthcare services. Data mining technique as well as Machine Learning algorithms aids to transform the generated data for covering meaningful information. Prediction of diseases at the right and appropriate time is a major concern for the health profession as it assists in prevention, diagnosis, cure, and to put forward an efficient effective treatment plan. In this scenario, this research aims to provide an overview of machine learning algorithms for predicting blood-related disease Anemia in the case of Nepal. The data were generated from the government hospital of Nepal and then cleaned, balanced, and applied machine learning algorithms for prediction. The performance of the machine learning algorithms was compared in terms of accuracy and feature

selection was applied for accuracy enhancement. The results showed that the Decision tree was the best performer and feature selection proved to be an appropriate methodology to improve the performance.

Keywords: Machine learning, algorithm, prediction, anemia, accuracy

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NA13: **Ram Chandra Dhungana**, Central Department of Mathematics, Tribhuvan University, Nepal

Title: **Budget Constrained Facility Allocation Optimization in Evacuation Network**

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Coauthors: Iswar Mani Adhikari

Abstract: Decision-making and analysis have been essential components of management science since the dawn of civilization. In order to address real-world problems effectively, decision-makers must consider multiple objectives and factors, and the problems must be transformed into multi-criteria decision-making problems. This requires a comprehensive understanding of the problem and the ability to weigh different criteria in order to make the best possible decision. This research aims to combine network facility location and contraflow with switching cost approaches in order to solve evacuation network problems more efficiently. The FlowLoc problem seeks to allocate facilities in the network with minimum flow loss, while the contraflow approach is widely accepted in evacuation planning to increase the outbound capacities of roads. Additionally, budget constraints are taken into account to ensure that resources are not exceeded. By combining these approaches, this research seeks to provide more effective solutions in management sciences.

Keywords: Evacuation network, abstract flow, facility location, FlowLoc problem, contraflow

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NA14: **Jeevan Kafle**, Tribhuvan University, Central Department of Mathematics, Kathmandu, Nepal

Title: **Novel physical-mathematical aspects of native Nepalese complex granular slides**

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Coauthors: Shiva P. Pudasaini, Parameshwari Kattel, Puskar R. Pokhrel, Bekha R. Dongol

Abstract: Granular landslides down mountain slopes that frequently occur as rapid motion of mixture of coarse and fine particles of different physical properties can be extremely destructive natural hazards. The complexity of landslide and its runout and deposition morphology depends on the granular nature, composition and release volume, channel geometry and the obstacles on the flow path. Here, we reveal some important novel results from uniquely designed laboratory landslide experiments with native Nepalese complex granular materials including food and fruit, and also geological grains in the laboratory Nepnova – Innovation Flows in Kathmandu. As the physical properties of the considered super-grains are epitome, we reveal several dynamical, propagational and depositional-morphological features of the associated slides. The dynamical and depositional complexity are the result of the very unusual physical and geometrical properties of these grains. The primary aim is to observe and measure novel phenomena, and apply them to the model validation and development of new physically-explained mathematical models aiming to solving some grand scientific and technological problems. This includes the measurement of grain, bulk and heap properties as well as the flow and depositional properties. Flow experiments focus on: the dynamics and deposition of slides, characterizing and explaining the mobility of mass flows including erosion, flow impacting different types of immobile and movable structures and multi-stage flow rerouting and re-distributions, particle dispersions and phase separation between grains of different physical properties and the determination of separation length in channelized and unconstrained flows. Experimentally measured quantities will be contrasted with our multi-mechanical, multi-phase physical-mathematical model equations that are widely used in simulating mass flow events. The results enhance our understanding of complex granular mixture flows with application to natural events and process engineering scenarios.

Keywords: Complex granular flows; Multi-phase mass flow; Mass flow mobility; Erosion-entrainment; Flow-structure-interaction-rerouting; Phase separation and dispersion; Separation length.

NA15: **Tanay Kumar Karmakar**, Indian Institute of Technology Guwahati, Guwahati, India

Title: **Improved Patch Dynamics Technique in Equation-free Multiscale Modelling**

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Abstract: Patch dynamics scheme of 'equation-free multiscale modelling' is one of the techniques which aims to extract the macroscopic information using the known microscopic model simulation in patches (which is a fraction of the space-time domain) that reduces the computational complexity. The main challenge of multiscale modelling is to develop bridging between different scales to transform and transfer information. In this study, an improved patch dynamics (IPD) scheme is proposed by distributing the gap-tooth time steppers within each long macroscopic time step. This distribution can be done in two ways, which are named as IPD of type-I and type-II. The gap-tooth time steppers are distributed in this way because it decreases the extrapolation time, thus improving the solution. In addition, one can choose either a uniform or non-uniform distribution of gap-tooth time steppers, as well as the extrapolation times according to the physics of the problem. Compared to patch dynamics scheme, IPDs of both types are capable of providing better accuracy with less computation time. Real-life problems are more appropriately addressed by IPD. In cases where the UPD scheme fails to converge for a long extrapolation time, both types of IPD can be applied. A one-dimensional diffusion problem was successfully solved using the entire method, confirming all the results previously stated.

NA16: **Parameshwari Kattel**, Tribhuvan University, Tri-Chandra Multiple Campus, Department of Mathematics, Kathmandu, Nepal

Title: **Coefficient of impact pressure and mobilization length: Analytical models**

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Coauthors: Shiva P. Pudasaini, Jeevan Kafle, Puskar R. Pokhrel, Chet N. Tiwari

Abstract: Based on the physical-mathematical principles, here, we present exact analytical mechanical models for the coefficient of impact pressure C_p^0 and the mobilization length L as a mass flow impacts a movable object. As the impact pressure of the flow overcomes the shear resistance of the object, the object moves as long as the pressure exerted by the flow is greater than the shear resistance. With this mechanical concept, we derive an exact analytical model for the coefficient of impact pressure, $C_p^0 = \frac{\mu_0 \rho_0 g_z h_0 A_0}{\frac{1}{2}\rho_p u_p^2 A_p}$, where C_p^0 is a dimensionless number, and appears to be the ratio between the obstacle shear resistance and the kinetic energy of the flow, per unit length. This can also be written in terms of the obstacle Froude number $Fr_0 = \frac{u_p}{\sqrt{g_z h_0}}$. Moreover, as the kinetic energy of the mobile object is consumed by the friction during its motion through a length L, the mobilized object stops. Based on this balance between the kinetic energy and friction, we derive an analytical model for the mobilization length of the object, $L = \frac{\frac{1}{2}u_0^2}{\mu_0 g_z}$. Equivalently, if the mobilization length is known, the impact velocity can be estimated. We conduct uniquely-designed innovative laboratory experiments with several native Nepalese complex food and fruit grains, and engineering and geological grains at the laboratory *Nepnova – Innovation Flows* in Kathmandu to check the physical significance, scope, and validity C_p^0 and L, including oblique-structure-induced multi-stage flow re-directions. We discuss the applicability of C_p^0 and L to real flow situations in designing protective civil defense structures as well as mitigating natural events and industrial transports of complex flows.

Keywords: Coefficient of impact pressure; Impact velocity; Mobilization length; Structure-induced flow re-direction.

NA17: **Real KC**, Okalhoma State University, Stillwater, USA

Title: **An Overview of Practical CFD and its Applications**

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Abstract: Computational fluid dynamics (CFD) is a technique within the field of fluid mechanics that utilizes computational methods to solve the complex partial differential equations that govern fluid flow and related phenomena. Due to the complexity of these governing equations, discretization techniques are used to transform them into a solvable system of algebraic equations that provide an approximation of the solution. In real-world scenarios, computational studies often provide more detailed information at a lower cost when compared to experimental studies due to limited scope and expense. However, care must be taken to ensure that the results are accurate, as CFD solutions are heavily dependent on boundary and initial conditions. The current study aims to offer an overview of applied CFD using the commercial software package, Star-CCM+. This includes the mathematical foundations of the governing equations, the discretization methods employed, and various applications of CFD, ranging from small to large scales.

NA18: **Harihar Khanal**, Embry-Riddle Aeronautical University, Daytona Beach, FL, USA

Title: **Exploration on some Modules and Libraries for High Performance Scientific Computing with Python**

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Abstract: Python is one of the most popular programming languages used in scientific computing. The flexibility of Python, with its easier syntax and vast ecosystem of modules and libraries, allows developers to rapidly prototype numerical computations. Unfortunately, when used for heavy computations, pure Python programs are notoriously slower than Fortran or C/C++ and extract only a small fraction of the performance available from the high-performance computing (HPC) system. Python is by default a dynamically typed interpreted language and is deprived of automatic parallelization through compiler optimizations available in the HPC clusters. Also, the Global-Interpreter-Lock (GIL) mechanism in Python prevents the performance benefits that comes from running multiple threads in parallel on a multicore CPU. There have been several attempts made to overcome these barriers using just-in-time (JIT) compilers, ahead-of-time (AOT) compilation in a C-like code, binding Python with faster compiled languages etc. Currently, an extensive list of modules, packages and libraries for parallel processing and multiprocessing in Python are available. In this talk, we explore parallelism in Python using some of such tools, namely NumPy, NumExpr, Numba, Multiprocessing, OpenMP-Cython and MPI4Py, and present their performance results on a pleasingly parallel Monte-Carlo simulation of a triple integral and a computationally demanding numerical integration of the Richards equation in a cylinder.

NA19: **Ramesh Khanal**, Balkumari College, Narayangarh, Nepal

Title: **Enhancing Security for Text Message Cryptography based on Basis Vectors**

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Coauthors:

Abstract: Cryptography is the practice and study of hiding information from all but those with the means or key to decode the message. Also, cryptography employs many different means of transforming standard data into unreadable forms. This paper's aim of the study was how to keep digital data secretly and send it privately through insecure channels based on basis vectors, that

activity builds around one of the techniques that illustrate an application of a set of basis vectors called matrix to cryptography The method involves two matrices of which one is used to encoding the encoding matrix and the other one to decode the decoding matrix. The characters, in the original message or stream, are assigned numerical values and the matrix must be row reduced echelon form for use in decoding. The proposed method is straightforward in its principle and has excellent potential to be applied to other situations where the exchange of messages is done confidentially.

NA20: **Yasunori Kimura**, Toho University, Funabashi, Japan

Title: **A unified approach to the convex minimization problems on geodesic spaces with curvature bounded above**

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Abstract:The convex minimization problem is one of the central topics of convex analysis. The recent development has considered it in complete geodesic space with curvature bounded above. In particular, many studies have proposed various approximation techniques to solve this problem using the concept of the resolvent operator. A resolvent operator for a convex function is defined as a unique minimizing point of a sum of a given convex function and a perturbation function whose choice corresponds to the upper bound of the curvature of the underlying space. For this reason, many results concerning the resolvent operators have been proved with their proofs corresponding to the curvature.

In this work, we show some results of the resolvent operators of convex functions with parametrized perturbation functions. Furthermore, our methods enable us to unify various proofs depending on the curvature, and we may describe the nature of the convex minimization problems on complete geodesic spaces.

NA21: **Ananda Prasad Panta**, Tribhuvan University, Kathmandu, Nepal

Title: **Optimization of Finite Capacity Markovian Queueing System with Vacations**

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Coauthors: Ram Prasad Ghimire

Abstract: This paper deals with the optimization of finite capacity multi-server queueing system with working breakdowns and multiple vacations of servers. We assume that customers arrive in the system according to a Poisson process and are served exponentially with first-come-first-served service discipline. The matrix analytic technique is used to find the steady-state probabilities and then obtain the expressions for various performance measures of the system, such as expected number of customers in the queue and system, expected waiting time in the queue and system etc. We construct the expected cost function and formulate an optimization problem to determine the minimum cost. The optimal number of servers and optimal system capacity for various parameters has been obtained at the minimum cost. A sensitivity analysis is also performed to explore the effects of different parameters on the performance measures of the system through the numerical illustrations.

NA22: **BDK Patro**, Rajkiya Engineering College, Kannauj, India

Title: **Water Quality Monitoring of River Ganga Using Non-linear Data Analytics**

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Coauthors: Shivam Sharma, Abhishek Bajpai

Abstract: The Ganga River is one of India's biggest and most significant rivers and the health and welfare of millions of people depend on the purity of its water. The traditional linear models

that have been used extensively to assess water quality have limitations in their ability to capture the intricate non-linear interactions between the water quality factors. On the other hand, non-linear data analytics are able to identify these linkages and can offer more precise and trustworthy estimates of water quality. In order to monitor the River Ganga's water quality, this study suggests a non-linear data analytics approach that entails gathering sensor data using IOT and studying a significant amount of water quality data. The results show that the proposed approach outperforms traditional linear models and can provide valuable insights into the water quality of the River Ganga.

NA23: **Gunakhar Pokharel**, Kathmandu Model Secondary School, Lalitpur, Nepal

Title: **Maximum Flow Evacuation Planning Problem over Network with Prioritized Arcs**

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Coauthors: Phanindra Prasad Bhandari, Shree Ram Khadka

Abstract: The network flow problem can be used in modeling evacuations. The evacuation planning problem aims to shift the evacuees from the risk zone to the safe zone efficiently using the existing road network. Literature is flourishing with different mathematical optimization models for the problem. The evacuation planning problem over networks with vertices, serving as temporary shelters, for given priorities has been studied in the literature. In this paper, we study a maximum flow evacuation planning problem over a network with arcs, denoting the road segments, of given priorities to be used to send the evacuees.

Keywords: Evacuation, Network flow, Maximum flow problem, Prioritized arcs.

NA24: **Puskar R. Pokhrel**, Tribhuvan University, Institute of Engineering, Pulchowk Campus, Department of Applied Sciences, Nepal

Title: **Multi-phase simulation of complex laboratory flows with native Nepalese supergrains**

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Coauthors: Shiva P. Pudasaini, Puskar R. Pokhrel, Jeevan Kafle, Parameshwari Kattel, Tek B. Budhathoki

Abstract: Complex granular flows as mixture of particles of different physical properties are abundant in nature and process engineering, including landslides, debris flows and avalanches, often causing devastation to life and properties, and the food processing and transport plants. Proper understanding of the flow dynamics, run-out and deposition morphology are important to scientists and engineers as they provide essential information in developing hazard maps and decision making in constructing settlements, civil and defense structures. The difficulty increases with the complexity of granular composite and the flow impacting objects such as forest, bridges, power stations and supply lines, and settlements. One of the still-poorly-understood aspects is the impact pressure coefficient as the flow encounters the object. Based on the mechanical principle, that as the impact pressure overcomes the shear-resistance the object moves, we have constructed an exact analytical model for the coefficient of impact pressure C_p^0 as a mass flow impacts a movable object. Similarly, considering the balance between the kinetic energy and friction, we have derived an analytical model for the mobilization length L of the object. Here, we consider our own, widely used, physically-based mathematical multi-phase mass flow models and high-resolution, efficient, computational tool to simulate the impact pressure coefficient and the mobilization length as the complex mass flow impacts mobile objects. Simulation results will be contrasted with experimental findings produced in the uniquely-designed innovative laboratory experiments with several native Nepalese surergrains - food grains, and engineering and geological granules at the laboratory *Nepnova - Innovation Flows* in Kathmandu. This includes the dynamics and deposition of channelized and

unconstrained granular slides, erosion and mobility of mass flows, flow impacting different types of immobile or movable structures, multi-stage flow diversions, phase separation between grains of different physical properties, and determination of separation length. In particular, this enables us to obtain the physical significance, scope and validity of our multi-phase mathematical model in relation to the impact pressure and the mobilization length. This opens the application possibility of C_p^0 and L in combination to our unified modelling frame to real flow situations in designing protective civil defence structures as well as mitigating natural events and industrial transports of complex flows.

Keywords: Multi-phase flows; Mathematical simulations, Flow-structure-interaction; Coefficient of impact pressure; Mobilization length, Erosion-entrainment; Phase separation.

NA25: **Nicolae Tarfulea**, Purdue University Northwest, Hammond, USA

Title: **On Solving Constrained Hyperbolic Differential Equations Numerically**

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Abstract: Important mathematical models involve hyperbolic differential equations supplemented by constraints on infinite domains. In general, for the pure Cauchy problem one can prove that the constraints are preserved by the evolution. That is, the solution satisfies the constraints for all time whenever the initial data does (e.g., Maxwell's equations and Einstein's field equations in various hyperbolic formulations). Frequently, the numerical solutions to such evolution problems are computed on artificial space cutoffs because of the necessary boundedness of computational domains. Therefore, well-posed boundary conditions are needed at the artificial boundaries. Moreover, these boundary conditions have to be chosen in such a way that the numerical solution on the cutoff region approximates as best as possible the solution of the original problem on infinite domain, and this includes the preservation of constraints. In this talk, I will present a few ideas and techniques for finding constraint preserving boundary conditions for a large class of constrained hyperbolic equations.

NA26: **Sudarshan Tiwari**, RPTU Kaiserslautern-Landau, Kaiserslautern, Germany

Title: **Disease contagion models coupled to crowd motion and mesh-free simulations**

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Abstract: In the recent years the modeling and simulation of disease spreading in pedestrian crowds becoming a very important topic . In this talk, we consider the influence of the crowd motion in a complex dynamical environment on the course of infection of the pedestrians. To model the pedestrian dynamics, we consider a kinetic equation for multi-group pedestrian flow based on a social force model coupled with an Eikonal equation. This model is coupled with a non-local SEIS contagion model for disease spread, where besides the description of local contacts, the influence of contact times has also been modelled. Hydrodynamic approximations of the coupled system are derived. We discuss different models for the infection rate, like the non-local infection rate, which is crucial for the coupling of pedestrian dynamics and disease spreading. Besides the modelling of the influence of the number of contacts and contact duration on the spreading of the disease, the influence of the spreading of an aerosol cloud is modelled via a drift-diffusion model coupled to the pedestrian motion. Simulations of the hydrodynamic model are carried out using a mesh-free particle method. Different numerical test cases are investigated, including uni- and bi-directional flow in a passage with and without obstacles.

NA27: **Bharat Raj Wagle**, School of Business, Pokhara University, Pokhara, Nepal

Title: **Performances analysis of closed queuing network in vehicle sharing system**

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Coauthors: Ram Prasad Ghimire

Abstract: Vehicle-sharing system is one of the hot issues in the context of economic and environmental degradation management of congestion in the transportation system. Our study has studied the performance of vehicle-sharing systems in the closed queueing network framework having M nodes and N number of vehicles arrived in the Poisson process and exponential service distribution with first come first serve discipline. Each node has n_i vehicles in acting, idle and vacation states arrived in λ_i, γ_i and ν_i rates respectively. Probabilities of n_i vehicles in i^{th} node derived by using equilibrium probability distributions functions with the help of a transition diagram. Convolution algorithm finding a normalizing constant that helps to obtain queueing network performances- utilization of i^{th} vehicle consisting of N vehicles in the network, the average number of vehicles at i^{th} node, expected total number of vehicles in the system, the average time of a vehicle that it spends in waiting as well as in service in the i^{th} node, the total waiting time of a vehicle in the queues in all the nodes, average throughput of a vehicle in i^{th} node in the system as well as system throughput and the probability that there are K or more vehicles in i^{th} node. To show real-life applications of the model the numerical results have been computed by using computer software. The model under study may attract the attention of researchers interested in the study of the vehicle-sharing closed queueing model.

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