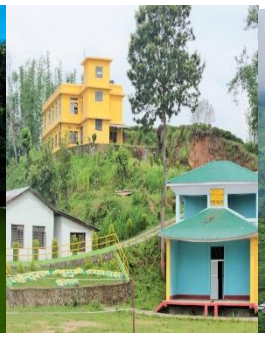
BOOK OF ABSTRACTS

National Conference on Mathematics and Its Applications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THE DIFFUSIVE LOTKA-VOLTERRA COMPETITION MODEL IN FRAGMENTED PATCHES I: COEXISTENCE

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Abstract: We consider a competitive model having a competition of two species u and v inside the domain with respective strengths of the competition $b_1 > 0$ and $b_2 > 0$. We consider the linear boundary condition such that a parameter λ influences both the differential equations as well as the boundaries. On the boundaries, we have γ_1, γ_2 involved which are related to the hostility of the exterior domain. We analyze the positive solutions of the model as the parameters b_1, b_2 and γ_1, γ_2 vary.
Keywords: Lotka-Volterra; Competitive model; Coupled solutions

SOLITON SOLUTIONS OF NONLINEAR EVOLUTION EQUATIONS VIA THE ENHANCED (G'/G)-EXPANSION METHOD

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Abstract: In this article, we consider two nonlinear equations named the Benjamin-Ono equation and the modified Benjamin-Bona-Mahony (mBBM) equation. The Benjamin-Ono equation describes a one-dimensional internal wave in deep stratified fluids and is a nonlinear partial integro-differential equation. Another modified Benjamin-Bona-Mahony (mBBM) equation is a variant of Benjamin-Bona-Mahony (BBM) equation. The BBM equation is applicable to the study of the Rossby waves in rotating fluids and drift waves in plasma. The enhanced (G'/G)-expansion method is presented to find the exact traveling wave solutions as well as soliton solitons of these two equations. The solutions with arbitrary parameters are achieved by this method is expressed trigonometric and hyperbolic functions. The properties of these solutions are shown by 3-D figures and expose different characteristics of these evolution equations. The resulting solutions demonstrate that the above method is very powerful and competent mathematical tool for finding abundant solutions and can be used for many other NLEEs in mathematical physics.
Keywords: Enhanced (G'/G)-expansion method; Benjamin-Ono equation; Modified Benjamin-Bona-Mahony equation; Exact traveling wave solutions

AN IN-HOST MODEL OF MEASLES VIRUS INFECTION

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Abstract: Measles is a human viral disease caused by a highly contagious virus called the genus Morbillivirus. The infection of this virus often induces strong measles virus-specific immune responses. In this work, we develop an in-host model describing the interaction between virus, host cell, and immune responses related to measles infection. We use our model to determine the effects of the antibodies produced during the immune response on controlling the virus infection. Specifically, we will obtain the infection-free equilibrium point, infected equilibrium point, and basic reproduction number. We further analyze the stability of the infection-free equilibrium point to identify the level of immune response needed for the successful control of measles virus infection.
Keywords: Immune system; Antibodies; Measles virus; In-host model

NUMERICAL ANALYSIS OF QUANTUM TUNNELING

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Abstract: Quantum tunneling is a phenomenon in which particles tunnel through a potential energy barrier whose height is larger than the particles' total energy. A height-based potential energy barrier produces three physical zones with three distinct wave characteristics. In the three regions, two sorts of solutions arise. The motion of a quantum-mechanical system is governed by the Schrodinger equation, a linear partial differential equation. Analytically solving the Schrodinger equation, we investigate the nature of the solution. The study focuses mostly on the particle's behavior. The purpose is to evaluate the probability of particle transmission or reflection through a potential barrier. Quantum tunneling serves as the basis for nanotechnology. It finds use in the tunnel diode, quantum computing, the scanning tunneling microscope, *etc*.
Keywords: Barrier tunneling; Schrödinger equation; Wave function; Transmission coefficient

RAYLEIGH GENERATED LOG-LOGISTIC DISTRIBUTION, PROPERTIES, AND APPLICATIONS

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Abstract: A new family of distribution has been proposed and presented as Rayleigh Generated family. A four parameters continuous distribution is proposed called Rayleigh Generated Log-logistic distribution as a special case of RG family of distribution. It is the generalization of Log-logistic distribution by using the cumulative distribution function of Rayleigh distribution. The statistical properties and random number generation of the distribution have been derived. Method of maximum likelihood and moments have been derived for the estimation of parameters. The age of the mother at the birth of a child and the waiting time (minutes) of the customer at the bank before receiving the service have been used to illustrate the usefulness, flexibility, and application of the proposed distribution. The chi-square test statistics, Akaike's Information Criteria, and Bayesian Information Criteria have been used to test the significance and validate the data. The proposed model is found to be more flexible and better fit the data significantly than some selected probability distributions.
Keywords: Hazard rate function; Reliability function; Waiting time; Age-specific fertility rate

SOME TECHNIQUES FOR SOLVABILITY OF QUADRATIC DIOPHANTINE EQUATIONS

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Abstract: In this paper, we present some results related to the open problem of unsolvability or solvability of quadratic Diophantine equations. Some quadratic Diophantine equations can be converted into Pell's equation, but not all. The Pell equation $x^2 - dy^2 = N$ has no integer solution if N is a quadratic non-residue modulo d. This equation becomes most interesting when $d \neq 1$, a positive, not a perfect square. Sometimes there are solutions for specific values of $d$and N, and sometimes there are also not. Lagrange solved Pell's equation $x^2 - dy^2 = 1$ using a simple continuous fraction. For a given$d$, one can identify the solvability or unsolvability of Pell's equation$x^2 - dy^2 = -1$ using the continued fraction expansion of $\sqrt{d}$, Quadratic Reciprocity Law and Legendre Symbol. We consider this problem from the view point of determining the computational complexity of classifying such d.
Keywords: Solvability; Diophantine equations; Integer solution; Complexity

NUMERICAL SOLUTIONS OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS USING CHEBYSHEV POLYNOMIALS

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Abstract: In this talk, we present a simple and effective Chebyshev polynomial scheme (CPS) combined with the method of fundamental solutions (MFS) and the equilibrated collocation Trefftz method for the numerical solutions of inhomogeneous elliptic partial differential equations (PDEs). CPS is applied in a two-step approach. First, Chebyshev polynomials are used to approximate a particular solution of a PDE. Chebyshev nodes which are the roots of Chebyshev polynomials are used in the polynomial interpolation due to their spectral convergence. Then the resulting homogeneous equation is solved by boundary type methods including the MFS and the equilibrated collocation Trefftz method. Numerical results for problems on various irregular domains show that our proposed scheme is highly accurate and efficient.
Keywords: Chebyshev polynomials; Particular solutions; Collocation Trefftz method; Poisson equations; Modified Helmholtz equations

STEAM EDUCATION AS/FOR TRANSFORMATIVE MATHEMATICS LEARNING

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Abstract: I have tried to explore how a hegemonic western cultural worldview supports perpetuating the disciplinary egocentric curriculum practices. It has established the western modern worldview, culture, and perspective as a universal standard and makes the learners unaware of their ways of being, knowing, and doing. Likewise, it engulfs humanitarian, biocultural, political, and spiritual perspectives of mathematics education. It signifies that we urgently need to revitalize mathematics education by incorporating newly emerging perspectives; one such perspective might be STEAM education. The primary concern of STEAM education is to acknowledge local and contextual ways of being, knowing, and doing. The recognition of the local cosmological knowledge, perspectives, and values support authenticating the learning process. The learning authentication widens the possibilities of active engagement of learners in the learning and decision-making process by deploying creative, critical, and imaginative thinking and skills. A deep engagement in a multi/inter/transdisciplinary learning process embraces the learners into bio-cultural differences; the lifelines of the human being support developing awareness, self-consciousness, and spiritual sensibility. An indication is that STEAM perspectives always focus on enriching transformative agendas to create more authentic, inclusive, and empowering educational practices. It also empowers the learners to act as change agents for enhancing socially, ecologically, and bio-culturally just society that underpins the transformation of mathematics education.
Keywords: Disciplinary egocentrism; STEAM education; Self-consciousness; Biocultural differences; Transformative pedagogy; Sustainable development

INFLUENCE OF PARTICLE CONCENTRATION OF RELEASE MASS ON DYNAMICS OF LANDSLIDE-GENERATED TSUNAMIS

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Abstract: Tsunamis are generated when a rapidly moving landslide or any other gravitational mass strikes a water reservoir by transforming its impact energy into the water body. The destructive effects induced by the waves are strongly influenced by the characteristics of channel geometry and particle concentration of initial release mass. The dynamics of these complex natural processes have been studied extensively using experimental, analytical, and computational models. Here, we employ a general two-phase mass flow model (Pudasaini, 2012) to perform numerical experiments and present geometrically three-dimensional, simulation results for the time evolution of both solid and fluid wave structures with varying particle concentrations in the two-phase initial release mass. The simulation results reveal that the concentration of grains in the released mass remarkably affects the dynamics of landslides, induced tsunamis, and their propagation. These studies can be applied to investigate the flow dynamics of a wide range of geophysical mass flows such as granular flows, debris flows, mud flows, and flash floods as well as GLOFs and the dynamics of water waves and submarine flow after the flow-reservoir-interaction.
Keywords: Two-phase mass flows; Particle concentration; Subaerial Landslide; Tsunami

KNIGHTS-AND-KNAVES PUZZLE

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Abstract: “Knights and Knaves Problem” originally presented by Boolos (1996) is considered the Hardest logic puzzle ever. It has several variants and modifications. There are several weird tales related to it. Some of the problems are interesting logical recreations.
Keywords: Hardest logic puzzle ever; Weird tales; Logical recreations

LEXICOGRAPHICALLY MAXIMUM FLOWS UNDER AN ARC INTERDICTION

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Abstract: Network interdiction problem arises when an unwanted agent attacks the network system to deteriorate its transshipment efficiency. Literature is flourished with models and solution approaches for the problem. This paper considers a single commodity lexicographic maximum flow problem on a directed network with capacitated vertices to study two network flow problems under an arc interdiction. In the first, the objective is to find an arc on the input network to be destroyed so that the residual lexicographically maximum flow is lexicographically minimum. The second problem aims to find a flow pattern resulting lexicographically maximum flow on the input network so that the total residual flow if an arc is destroyed, is maximum. The paper proposes strongly polynomial-time solution procedures for these problems.
Keywords: Network flow; Capacitated vertices; Lexicographically maximum flows; Network interdiction problem

CLOSED QUEUEING NETWORK ANALYSIS OF VEHICLE SHARING IN A CITY

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Abstract: Vehicle sharing is an immense issue in the world from the point of view of environmental protection, traffic management, and economics. Our study deals with the construction of a closed queueing network with a finite number of nodes and vehicles that provide the service to the riders. The customer's average arrival and service rate are provisioned to be heterogeneous on a first-come-first-served basis. Arrivals of the customers in the nodes are taken to be Poisson and the customer's service in exponential fashion. With the help of the transition diagram under study, $3(N+1)$ difference equations have been set up, which have been solved explicitly to obtain the probability of individual state conditions of vehicles. Moreover, the performance of the network's product form is obtained by using the Gorden and Newell theorem of closed queueing networks. Some numerical results with the help of MATLAB software have also been computed to show the validity and the applicability of the model under study.
Keywords: Queueing networks; Vehicle sharing, Heterogeneous arrival and service; Product form

A RELATION BETWEEN PYTHAGOREAN AND BIRKHOFF ORTHOGONALITY IN TERMS OF BOUNDED OPERATORS

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Abstract: This paper deals with the connection between reserving Birkhoff-James orthogonality and a new particular case of the Carlsson orthogonality in terms of non-zero linear operators in Banach spaces. The goal is to find the relation between reserving Pytharegorean orthogonality and Birkhofforthogonality. We prove that if a non-zero linear operator reserves Pythagorean orthogonality, then it also reserves Birkhoff orthogonality. We also prove the uniqueness property of orthogonality concerning the reserving Pythagorean orthogonality
Keywords: Normed linear space; Reserving orthogonality; Birkhoff-James orthogonality; Pythagorean orthogonality

TEACHING MATHEMATICS FOR SOCIAL JUSTICES

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Abstract: For several years, the purpose of teaching mathematics was to help learners solve routine mathematical problems. The focus was on mathematical concepts and delivering conceptual knowledge and procedural skills in regular classes. In the modern era, the discourses on the purpose of teaching mathematics have been extended toward social justice. There might be several injustices in the family, communities, and workplaces. As per the principles of critical theory and critical pedagogy, the roles of mathematics teaching should advocate for establishing social justice by raising the deep-rooted unjust practices. In this context, the authors have supported schoolteachers through various workshops and seminars to use critical pedagogy in school mathematics and address the social issues by teaching mathematics. The development of projects and implementation for mathematics teaching provides rich environments to raise multi-layered problems in societies and develop the courage to solve the issues using mathematical knowledge and skills. The schoolteachers, in the beginning, struggled a lot to develop the projects and connect them with social issues. Gradually, teachers came up with several authentic topics such as time and work distribution in the family, and why farmers are not rich? who benefits more in book publication? Mathematics in our kitchen, etc. In this presentation, we share different teacher-made projects to ensure the social justice perspectives. We also share the students; engagement through project-based learning and the transformation students realize during learning. This presentation can be useful to teachers, teacher educators, and researchers who advocate social justice through mathematics teaching.
Keywords: Social justice; Critical pedagogy; Project-based learning

MAXIMUM NETWORK FLOW ALGORITHMS: A COMPARATIVE STUDY

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Abstract: Maximum network flow problem has numerous applications in science, technology, and engineering. Many efficient solution algorithms have been established to solve the problem. In this paper, we compare some of the prominent and recent algorithms to the maximum network flow problem with respect to their running time complexities.
Keywords: Network flow; Maximum network flow problem; Algorithm; Complexity

PHYSICAL REALITY AND ESSENCE OF IMAGINARY NUMBERS

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Abstract: Recent investigations show that imaginary numbers have real physical meaning, and nowadays it is assumed that they are not mere mathematical artifacts, but they do exist. We show some cases that show the physical reality and essence of imaginary numbers.
Keywords: Imaginary number**;** Complex number; Multiverse

MODELING MULTIPHASE DEBRIS FLOODS DOWN A MEANDERING CHANNEL

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Abstract: Debris flows, floods, and hyperconcentrated flows are effectively two-phase flows, where the fluid dynamics are considerably to remarkably affected by the solid phase forces and the interaction between the phases. Many studies and modeling attempts were carried out by using empirical or effectively single-phase models. We present some existing models in the dynamics of debris floods down meandering channels. Moreover, we present some simulation results demonstrating debris floods in meandering channels, employing a general two-phase debris flow model developed by Pudasaini (2012). The results will be useful to understand the dynamics of the constituent phases of debris flows/floods down continuously meandering channels as seen in the natural paths of rivers, which is relevant in the Nepali context since Nepal is often hit by catastrophic floods, especially during the monsoon.
Keywords: Debris floods; Meandering channel; Sinuosity; Two-phase flows

C [*a, b*] AS THE BACKBONE OF EVOLUTION OF FUNCTIONAL ANALYSIS

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Abstract: The purpose of the present article is to demonstrate amply the role played by C [a, b], the class of all continuous functions defined on the closed finite interval [a, b], in the shaping of Functional Analysis. It seems that this space has been just in front of every great mathematician whose work has proved to be a part of the foundation leading to the establishment of major developments in the subject. It is shown that C [a, b] was also the basis of the initiation of studies of integral equations. Functional Analysis could be thought of as the analysis of functions defined on topological space whose points are themselves functions. We aim at showing that this topological space was initially C [a, b] in most of the important cases.
Keywords: Evolution; Functional analysis; Topological space; The Stone-Weierstrass theorem; The Ascoli-Arzela theorem

CORONA THEOREM IN BOUNDED ANALYTIC FUNCTION ON THE UNIT DISC

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Abstract: In 1962, L. Carleson's proved the famous Corona theorem on H^∞ space in the unitdisc D. The purpose of this presentation is to demonstrate amply the pioneering role played by H^∞ space function, the set of all bounded analytic functions in the unit disc D and prove the Corona theorem in H^∞ space. In this presentation, the Corona data can be used and the solution of the Corona theorem can be obtained. The Corona solution depends on the number of functions and some constants will also be explained briefly. An application of Corona theorem on Q_p space and the multipliers in Q_p space will also be taken into account.

Keywords: Corona data; H^∞ space; Unit disc; Q_p space

ANALYSIS OF THE METABOLIC RATE AND SKIN LAYERS THICKNESS FOR HUMAN THERMOREGULATION IN A TWO-DIMENSIONAL FEM MODEL FOR ADULTS AND AGING

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Abstract: Adult and aging are the natural stages that occur in the human body. The basal metabolic rate decreases throughout aging as compared to an adult. The epidermis and dermis layer's thicknesses become thinner on increasing the aging period than an adult. The present paper deals with the two-dimensional model of thermoregulation rooted in basal metabolic rate and skin layer thickness. The finite element method (FEM) is used to evaluate the realistic temperature of skin layers. The results have shown the epidermis and dermis layers' temperature is higher in aging as compared to adults. But subcutaneous tissue temperature slightly decreases during aging than in the adult period.

Keywords: Basal metabolic rate; Skin layers thickness; Thermoregulation; Ambient temperature

DISLOCATED METRIC SPACE AND SOME FIXED-POINT THEOREMS

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Abstract: In 1986, S. G. Matthews initiated the concept of dislocated metric space under the name of metric domains. In 1994, S. Abramski and A. Jung presented some facts about dislocated metric in the context of domain theory. In 2000, P. Hitzler and A. K. Seda generalized the celebrated Banach contraction principle in complete dislocated metric spaces. In 2003, W.A. Kirk, P. S. Shrinivasan and P. Veeramani introduced the notion of cyclic contraction and established fixed point results for such contractions. Since then, many authors proved fixed point results in cyclic contraction mappings in metric space. In 2013, M. A. Ahmed, F. M. Zeyada and G. F. Hasan introduced the notion of generalized types of dislocated metric spaces so called left and right dislocated metric spaces. In this paper, we discuss some fixed-point theorems in cyclic contractions of left and right dislocated metric spaces and also some fixed-point results related to this space.
Keywords: Fixed point; l *d*-metric; *rd*-metric; Cyclic contraction

ARE MATHEMATICS TEXT BOOKS IN NEPAL SERVING THEIR PURPOSE?

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Abstract: Textbooks are considered one of the primary resources for teaching and learning mathematics. Moreover, mathematics teachers in Nepal often use textbooks as a primary resource of teaching materials. Existing research shows a correlation between the quality of textbooks utilized in the classroom and student achievement. In this regard, it is necessary that textbooks should be carefully developed and evaluated periodically for their quality. Using the middle school (grades 6, 7 & 8) mathematics textbooks published by Curriculum Development Center, we investigated multiple features of textbooks that are essential for promoting a deeper understanding of mathematics. We also compared the algebra contents of our sample with the textbooks from high-performing countries (Finland, China, Taiwan, Singapore, and the USA) in the international assessments such as TIMSS and PISA. Our findings reveal that the majority of problems in Nepali mathematics textbooks are closed-ended, non-contextual, and cognitively less challenging. Additionally, most problems are written in symbolic representations and worked-out examples similar to most exercise problems are available. We discuss the implications of our findings regarding the development of mathematics textbooks in Nepal.
Keywords: Mathematics in Nepal; Textbook; Middle school mathematics; Cross-national comparison

GLOBAL REGULARITY FOR THE 2D MAGNETOHYDRODYNAMIC (MHD) EQUATIONS WITH PARTIAL DISSIPATION AND DIFFUSION

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Abstract: Whether the classical solution of the 2D MHD equations can develop a finite time singularity or global regularity is an outstanding open problem. We study the global existence and regularity of classical solutions to the 2D incompressible MHD equations with partial dissipation and diffusion. In this presentation, we discuss some of the recent results and open problems related to MDH equations.
Keywords: MHD equations; Partial dissipation; Global regularity

ASSESSING THE IMPACT OF CONTROL MEASURES ON DENGUE DISEASE TRANSMISSION DYNAMICS

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Abstract: Dengue is an infectious vector-borne disease caused by viruses named DEN 1 – DEN 4 which is spread via the bite of infected Aedes mosquitoes. In this work, a deterministic compartmental model with control strategies is presented. Dengue infections that occurred in Nepal have been used to estimate the parameters of the model. The stability of the model's equilibrium points and the sensitivity analysis of the model parameters have been carried out. Numerical discussion is made to observe the impact of control measures graphically. The present study suggests that spraying insecticides and the use of mosquito repellents can significantly reduce the transmission of dengue infection.
Keywords: Compartmental model; Control measures; Stability; Sensitivity analysis; Parameter estimation

INTEGRATED NETWORK OPTIMIZATION MODEL OF EXCLUSIVE BUS LANE

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Abstract: A transportation system with an exclusively reserved lane for public buses or high passenger vehicles is called an exclusive bus lane (EBL). The EBL system can help to reduce traffic congestion and users of private vehicles in the city. A properly managed EBL system can meet the target of the transportation authority. In this research study, we survey network optimization EBL models along with the review min-max dynamic optimization EBL model in favor of three modes of vehicles. Major upgraded terms on a reviewed model have been taken as prior origin count of the bus travel time, bureau of public road (BPR) constraint to the car mode, anda maximum number of motorcycle rider constraints. Among them, BPR constraint has impacted significantly over objective function as well as planning of EBL on the transportation network. Traffic data related to the motorcycle mode had been estimated using a statistical tool by increasing the capacity of arcs and without loss of generality with original data of buses and cars. We prefer a parallel genetic algorithm for the solution of the problem and proved that the complexity of the problem is NP-hard. A numerical example is revealed as are viewed optimization network model to achieve the feasibility that yields an optimal solution.
Keywords: Exclusive bus lane; Vehicle mode; BPR constraints; Parallel genetic algorithm

MATHEMATICAL ANALYSIS OF COVID-19 IN NEPAL

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Abstract: In the present work, the transmission dynamics of the disease is analyzed mathematically using SIIR compartmental model. The dimensionless basic reproduction number, R_0 is computed using the Next Generation Matrix method. Both local and global stability of the equilibrium points of the model is discussed with the help of the basic reproduction number. The occurrence of bifurcation in the model is investigated. Simulations are made to observe the mathematical results graphically.
Keywords: COVID-19; Compartmental model; Basic reproduction number; Stability; Bifurcation

APPLICATION OF FUZZY THROUGH BELLMEN – ZADEH MAXIMUM METHOD

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Abstract: Fuzzy logic is a multiple-valued logic in which variable truth values can be any real number within 0 and 1. It has a wide range of real-world applications. In our daily lives, we may confront several problems in selecting the best of the best for a tangible result. In the existing literature, there are different criteria for ranking options in the field of decision-making under uncertainty in a crisp environment. In this study, we will discuss the difficulties encountered while deciding the best of the best, as examined by the Bellmen-Zadehmaximin technique. It is used to address such problems by employing fuzzy real numbers.
Keywords: Fuzzy logic; Membership function; Fuzzy numbers; Decisionproblem; Alternatives

TEMPORAL VISIBILITY GRAPHS FOR ELECTROENCEPHALOGRAM SIGNALS CLASSIFICATION

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Abstract: Recent research works have shown tremendous interest in graphs and graph neural networks to generalize deep learning methods in non-Euclidean data. In the process, the main challenge here is to construct an appropriate network that manifests the characteristics of the data. Exploiting the dynamic data having long-term dependencies and chaotic property through the networks is another issue in a graph learning community. We propose a novel deep learning framework to make the most use of temporal data. In the process of transforming evolving data into complex networks, we convert it into visibility graphs using the concept of visibility among the temporal signals. Then the graphs so obtained will have the structural information referring to temporal points as the nodes and the visibility as the link between the nodes. We construct visibility graphs on a real-world electroencephalogram dataset for signals classification and the effectiveness of our proposed method is validated on this data set.
Keywords: Visibility graphs; Graph neural networks; Electroencephalogram; Dynamic signals

INNOVATIVE PEDAGOGIES FOR MEANINGFUL MATHEMATICS LEARNING: SHARING OUR LIVED EXPERIENCES

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Abstract: In the context of Nepali Mathematics Education, Mathematics is considered a very difficult subject to teach and learn. Many teachers and students think that Mathematics is a subject for scoring good marks/grades in the examinations. However, based on our lived experiences in Mathematics Education, we have realized that Mathematics is neither a difficult subject nor only for scoring good marks/grades. Instead, Mathematics is life itself. In this context, we raise a pertinent issue, "How do various innovative pedagogies challenge disciplined-based pedagogy to enhance meaningful learning of Mathematics?" We use collaborative auto-ethnography as a research methodology to explore our innovative pedagogical practices from our memory lanes and draw meanings as research outcomes from different STEAM education lenses. This paper, therefore, discusses how disciplined-based pedagogy can be challenged and reformed by various innovative pedagogies for meaningful mathematics learning based on our lived experiences.
Keywords: Discipline-based pedagogy; Innovative pedagogies; Lived experiences; STEAM education; Collaborative auto-ethnography

EXPLORING THE MEANINGS OF A LIMIT OF A FUNCTION CONSTRUCTED BY UNDERGRADUATE STUDENTS

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Abstract: The limit of a function is one of the very important concepts in Real Analysis (RA) because it provides a basis for other concepts such as continuity, derivative, and integral of a function. Therefore, the performance of students in RA may largely depend on the students' understanding of a limit of a function. It is found that there is a poor performance of many students in RA in Nepal and beyond. Therefore, knowing how students understand the concept of a limit of a function might be the first step toward improving performance in RA. In this scenario, this study was conducted to explore the meanings of a limit of a function that Undergraduate Students' have constructed. The social constructivism of Paul Ernest was taken as a theoretical framework for the study. Task-based interviews with eight students studying Mathematics Education at B. Ed. program were conducted to generate qualitative data under an interpretive paradigm. Subjective knowledge of students and the way of interpreting the concept of a limit of a function were kept at the center. Interview transcripts were coded, categories were formed, and then eight themes were generated. The themes are, Weak in connecting networks of representations of RA concepts; Lack of linguistic knowledge; Insufficient knowledge of logical rules and their application; Dominance of symbolic representation; Construction of unacceptable meanings; Understanding of concepts in a procedural way; Approach of rote memorization; and Error in reading symbols. The findings of this study might help to teach concepts of RA in a meaningful way.
Keywords: Limit of a function; Social constructivism; Representation; Meaning construction; Understanding

FRACTIONAL-ORDER DERIVATIVE MODEL OF DENGUE DISEASE TRANSMISSION DYNAMICS IN NEPAL

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Abstract: Here, we study the dengue disease epidemic model by using fractional-order derivatives. The least-squares method is used for estimation of the parameters for the dengue infections recorded in the year 2019, the largest-ever outbreak occurred in Nepal. The reproduction number is obtained using the next-generation matrix method. Two equilibrium points: disease-free and endemic points are obtained and their stability is studied. Simulation is carried out to reveal the mathematical results graphically. Furthermore, the real data is well fitted with the model for a memory level $\alpha = 0.93$.

Keywords: Dengue fractional-order model; Basic reproduction number; Stability analysis; Parameter estimation; Numerical results

A STUDY ON DYADIC OPERATORS

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Abstract: Dyadic techniques have been proved to be very useful tools in Harmonic analysis so it has become a very active area in the era of research in Mathematics in recent years. Dyadic operators such as Multi-linear paraproducts, Multi-linear Haar multipliers have vital importance in Harmonic analysis because dyadic techniques are proved to be useful in the study of singular operators such as Calderon-Zygmund operators. T. P. Hytonen proved the famous A_2 theorem by representing a linear Calderon-Zygmund operator as an average of dyadic operators. We present the importance of the dyadic operator and brief notes on the dyadic interval, dyadic grid, BMO space, and singular integral operator.

Keywords: Dyadic interval; Dyadic grid; Singular integral operator; CalderonZygmund operator; BMO space

NEW VARIANTS OF NEWTON'S METHODS FOR SOLVING NONLINEAR EQUATIONS

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Abstract: In this work, two Newton type iterative methods have been developed to find the real root of univariate nonlinear equations. One of these is obtained by simple modification of double Newton's method and the next is obtained by the modification of midpoint Newton's method. For the modification, McDougall and Wortherspoon iterative scheme is used. The study shows that both convergence order and efficiency index of modified double Newton's method is higher than the existing one but in both methods, the same number of functions and derivatives are evaluated per iteration. The convergence order of modified midpoint Newton's method is 5.25 and in this method, two more functions are needed to evaluate per iteration compared to midpoint Newton's method with convergence order 3. Finally, some numerical examples are demonstrated to compare the performance of newly introduced methods with existing methods.
Keywords: Newton's method; Nonlinear equations; Order of convergence; Efficiency index

DATA AUGMENTATION WITH MOBIUS TRANSFORMATION

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Abstract: Data augmentation has led to substantial improvements in the performance and generalization of deep models, and remains a highly adaptable method to evolving model architectures and varying amounts of data—in particular, extremely scarce amounts of available training data. Mobius transformations are bijective conformal maps that generalize image translation to operate over complex inversion in pixel space. As a result, Mobius transformations can operate on the sample level and preserve data labels.
Keywords: Network; Data augmentation; Mobius transformation; Pixel space; Conformal maps

AXISYMMETRICBIOHEAT TRANSFER MODEL FOR CLOTHING SYSTEM FOR SWEATING AND METABOLIC EFFECTDURING PHYSICAL EXERCISE

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Abstract: Physical exercise is one of the processes of keeping the human body healthy, fit, and fine. Sweating due to physical exercise, on one hand, helps to lose heat from the skin. Clothing, on the other hand, prevents the body from losing more heat from the skin and protects from adverse climatic conditions. So, we develop a 2*D* asymmetrical bio-heat transfer model incorporating time-dependent metabolism with sweating and clothing effect at the boundary. Crank-Nicolson Scheme has been used to solve the model and we observe the metabolic, sweating, and clothing effects on the human body during physical exercise. Results show that the increased exercise time increases the metabolism as well as body core temperature. The temperature in the radial direction near the skin surface slowly decreases due to sweat evaporation at the skin surface. These parameters together with clothing at the boundary control the human thermoregulatory system.
Keywords: Asymmetrical bio-heat transfer model; Crank-Nicolson Scheme; Sweating and clothing effect; Human thermoregulatory system

SET THEORETIC OPERATIONS ON FUZZY SETS

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Abstract: The notions of containment and equality play a central role in the case of fuzzy sets. In this paper, we deal with these notions regarding union, intersection, complement, and difference of fuzzy sets. These operations are also called standard operations on fuzzy sets. This paper serves the purpose of divulging the difference in approach regarding the concept of theoretic operations in the classical (or traditional) set and fuzzy set.
Keywords: Classical set; Fuzzy set; Standard operations

FIXED POINT THEORY AND COMPATIBLE MAPPING OF TYPE (*K*)

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Abstract: Fixed point theory is an important part of non-linear functional analysis since 1960. Nowadays, fixed point theory is one of the most dynamic research areas, with lots of applications in various fields. In 1986, G. Jungck introduced the notion of compatible mappings and many authors introduce different types of compatible mappings. In 2014, Jhaet. al. introduced the new notion of compatible mappings of type (*K*) in metric space and extended it to fuzzy metric space with some common fixed point theorems using compatible mappings of type (*K*).The purpose of this paper is to study the fixed point theory and compatible mappings of type (*K*) in metric space and fuzzy metric space.

Keywords: Fixed point; Compatible mappings; Fuzzy metric space; Compatible mappings of type (*K*)

DATA DRIVEN MODELS FOR THE RISK OF COVID-19 INFECTION AND HOSPITALIZATION: CASE STUDIES ON DELTA AND OMICRON SURGES IN NEPAL

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Abstract: The COVID-19 pandemic continues worldwide with multiple waves due to the emergence of new strains of the Corona Virus. Nepal has already faced three waves of COVID-19 with dominating wild-type, Delta, and Omicron variants of SARS-CoV-2. Notably, the transmission and hospitalization during different waves are found to be quite different, indicating the need for the real-time estimation of the risk of transmission and hospitalization for the proper policy design and health care management. We will present a novel modeling approach for estimating the risk of transmission and the risk of hospitalization during a pandemic. We use our model to compare these risks during the second wave (Delta variant) and the third wave (Omicron variant) in Nepal. We will also discuss the risk-based analysis on the effectiveness of control measures to minimize transmission and hospitalization.

Keywords: COVID-19; SARS-CoV-2 variants; Risk of transmission; Risk of hospitalization

GRADE 12 STUDENTS' ANXIETY TOWARDS MATHEMATICS

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Abstract: Nepal, like other science and the technology-dominated world, is surviving in a very fast-changing political and socio-economic environment and is rapidly moving towards information and knowledge society that require a soundly based mathematics education. The best way to cope with this is to equip the young generation with appropriate knowledge and skills in mathematics. Keeping this view in mind, this research study has been undertaken to investigate the grade twelve science students' anxiety towards mathematics.
Keywords: Students; Anxiety; Mathematics

A STUDY ON ORTHOMODULAR LATTICES FOR COMPACT TOPOLOGICAL SPACES

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Abstract: Here, we have studied orthomodular lattices (OMLs). The properties of OMLs on compact topological spaces with some theorems, examples, and lemmas are explained to make the topic clearer. OMLs on compact topological spaces bear completeness, atomic, and meet continuity properties. It is found that for the finite real Hilbert spaces *H*, the atomic complete orthomodular Lattices *L* is an order Topological OMLs with discrete and also noncompact order property.
Keywords: OML; Compact totally disconnected semi lattices; Boolean rings;Principle Ideals; Hypercompactness

BOUNDED ORBIT SET OF HOLOMORPHIC SEMIGROUPS

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Abstract: In classical holomorphic dynamics, we study the dynamics of cyclic holomorphic semigroups generated by a single holomorphic function. One way of partitioning the complex plane is into the Fatou set where the behavior of dynamics is stable and the Julia set where the behavior of dynamics is unstable. Another way is into the escaping set, bounded orbit set, and neither bounded nor escaping set by seeing the behavior of orbit under the function. Later many mathematicians studied the dynamics of noncyclic holomorphic semigroups generated by more than one holomorphic functions and developed many results related to Fatou, Julia, and escaping set of holomorphic semigroups. Here, I particularly discuss the bounded orbit set of general (cyclic and noncyclic) holomorphic semigroups.
Keywords: Semigroup; Holomorphic function; Holomorphic semigroup; Bounded orbit set

STEAM SKILLS IN MATHEMATICS: EXAMPLES FROM THE CLASSROOMS

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Abstract: STEAM education is a pedagogical approach that is interdisciplinary and multidisciplinary. These pedagogical approaches have now shifted away from the disciplinary format and toward an integrated approach. As demonstrated in the first author's STEAM experiments, this presentation will discuss some of the STEAM skills that can be applied in everyday life in mathematics. Despite their opposition to the skills and concepts, some educators continue to be critical of a popular discourse that suggests that classroom instruction in the twenty-first century is less likely to connect to daily life. When exploring STEAM concepts, various approaches can be used to encourage students' imagination and participation in a variety of activities that take place both inside and outside the mathematics classroom. To maximize opportunities, every learner must understand STEAM skills and concepts. The presentation will also highlight and share the critical STEAM skills to teach in schools and universities, such as problem-solving, communication, creativity, and collaboration. During this section of the presentation, critical thinking will also be discussed. Because of the skills discussed, learners will be able to make action-oriented decisions and work through challenges throughout their lives.
Keywords: STEAM; Pedagogical; Skills; Interdisciplinary; Multidisciplinary; Action-oriented

MODELLING HUB LOCATION PROBLEMS IN PUBLIC TRANSPORTATION

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Abstract: Due to globalization, crowded transportation networks, increase in the origin-destination services in terms of passengers and commodities, concern for environmental pollution, and safety and security reasons, optimizing public transportation problems is becoming quite challenging. The objective is to minimize the overall public transportation cost between the origin(source) node and destination(sink) node by using the hub location problem model, formulating and finding the direction of the solution effectively. Hubs are the facilities that collect flow from a set of sources and distribute it to the required destination. Hub location problems (HLPs), aiming to minimize the total cost, are dealt with to determine and allocate major facility nodes as hub nodes. A model of HLP in public transportation networks is formulated here, depending on some existing formulations. To derive such a model, some of the basic assumptions of HLP are relaxed, which are usually satisfied in hub location problems but are not useful for public transportation networks. The main model is formulated by a flow conservation law based on network design formulations, in which the constraint that all flow has to be routed through some hub nodes. Some existing solution approaches for the model are also presented.

Keywords: Hub; Spoke; Location; Public transportation; Model

KdV TYPE EQUATIONS AND VANISHING VISCOSITY

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Abstract: In this presentation, we mainly discuss the KdV type equation. The general KdV equation is given by $u_t + au_x + 2buu_x + cu_{xxx} - du_{xx} = 0; u(x,0) = u_0(x)$, where a, b, c, d are parameters. We discuss various cases depending on the values of $a, b, c,$ and d. We here present the analytical approach and different numerical tools to deal with the *KdV* type equations and some numerical simulations for the particular cases.

Keywords: *KdV* equation; Viscosity; Nonlinearity

MATHEMATICAL STUDY OF EFFECT OF TEMPERATURE ON TRANSMISSION DYNAMICS OF DENGUE DISEASE

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Abstract: Dengue is an infectious disease that is found in tropical and subtropical regions of the world. It is a vector-borne disease that is transmitted by the infected female *Aedes* mosquitoes and is caused by any one of four types of dengue viruses, DENV 1 - DENV 4. While many DENV infections produce only mild illness, DENV can cause an acute flu-like illness. Occasionally this develops into the potentially lethal complication called severe dengue. We use the SEIR model to study the transmission dynamics of dengue disease. The model consists of four compartments namely, Susceptible, Exposed, Infected, Recovered for the human population, and four compartments namely Immature, Susceptible, Exposed, and Infected for the mosquito population. This model describes the effect of temperature on the transmission dynamics of dengue disease. In the present work, the basic reproduction number of the model is computed using Next Generation Matrix Method. The effect of temperature on the number is studied. Furthermore, simulations are carried out to study mathematical results graphically.
Keywords: Dengue disease; SEIR model; Reproduction number; Sensitivity analysis

ICT IN TEACHING-LEARNING MATHEMATICS

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Abstract: The field of education enjoys a high level of respect in society. This era has been engulfed by the spellbinding expansion of information and communications technology (ICT) throughout the world. ICT has seized the opportunity to become an integral part of society, affecting the atmosphere of the teaching and learning process. As a result, the field of mathematics education and learning has gained a foothold in the field of technology. Creating an effective communication environment, utilizing ICT hardware and software, and expanding the teaching-learning options are just a few of the benefits that ICT has brought to areas that practice teaching and learning. The importance of information and communication technology (ICT) in the teaching and learning process has risen in recent years because it facilitates the teaching and learning process, creates a conducive learning environment, and assists learners in developing creative thinking and self-confidence. When it comes down to it, information and communication technology (ICT) has evolved into a repository of knowledge that bridges the gap between mathematics teachers and students. This work demonstrates the importance of information and communications technology (ICT) in the evolving mathematics teaching and learning community.
Keywords: Technology; Teaching; Learning; Information

ETHNOMATHEMATICS: GEOMETRY AND ARCHITECTURE OF THE THARU TRADITIONAL HOUSES AT CHAKHOURA MUSEUM

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Abstract: Tharu is one of the indigenous communities having their distinctive culture and practices. They have their own mathematical ideas and concepts practiced to perform everyday activities. The study of mathematical ideas and knowledge practiced in a particular group of people is known as ethnomathematics. However, it is generally ignored by the formal curriculum. This study is intended to uncover the mathematical concepts embedded in the construction of traditional Tharu houses at the Chakhoura museum. For this purpose, this research is carried out with the observation and documentation analysis method for data collection. The re-sketching of the image of the traditional houses obtained in the field is carried out to facilitate the art, structures, and designs of construction systems of the traditional houses. Most of the local knowledge developed by Tharu communities regarding the architecture of traditional houses is usually based on intuition, estimation, observation, and practice handed down from generation to generation closely related to their local culture. Therefore, emic ethnomodeling is used to explore the mathematical ideas embedded in the architecture of traditional houses. The result showed that the architecture of the Tharu traditional houses demonstrates sophisticated geometrical objects, namely, angle, line, parallel line, triangle, rectangle, square, pentagon, circle, cylinder, beam, and so on. The result also showed that the geometrical ideas contained in the Tharu traditional houses include a triangular prism, rectangular parallelepiped, cut and cut cone, pyramid, and the concept of symmetry and reflection. Thus, the result of this study exhibits the diversity and sophistication of mathematical practice in traditional houses made by Tharu communities that have a strong foundation in popular scientific understanding, such as geometric shapes in arts, crafts, architecture, and design.
Keywords: Ethnomathematics; Architecture; Culture; Geometry; Indigenous knowledge

OPTIMAL METHODS FOR SOLVING NONLINEAR EQUATIONS AND THEIR BASINS OF ATTRACTION

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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 numerical examples, and the results are compared with some known methods of the corresponding order. The proposed methods are tested on some problems related to engineering and science. Furthermore, applying these methods to quadratic and cubic polynomials, their stability is analyzed by means of their basins of attraction.
Keywords: Non-linear equations; Potra-Pták method; Complex dynamics; Engineering examples; Basin of attraction

FEM MODEL FOR VERTICALLY ATMOSPHERIC POLLUTANT DISTRIBUTION WITH DRY DEPOSITION AND GRAVITATIONAL SETTLING VELOCITY EFFECTS

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Abstract: The purpose of this work is to develop one-dimensional unsteady state model for atmospheric pollutants distribution in the vertical direction in the troposphere emitted from a point source, the point source is assumed to be on the lower boundary of the troposphere. The chemical reaction and diffusivity of pollutants are assumed to vary with vertical height. So, for the simulation purpose, the troposphere is divided into six layers. Hence the finite element method together with Crank-Nicolson method is used to simulate the model results. The model also incorporates the study of the effects of dry deposition and gravitational settling velocity in the first layer of troposphere measured to the earth's surface.

Keywords: Dry deposition; Gravitational settling velocity; Eddy-diffusivity; Finite element method; Crank-Nicolson Method

EXPECTATIONS OF UNDERGRADUATE STUDENTS FROM TEACHERS IN LEARNING MATHEMATICS: A STUDY IN MID-WEST UNIVERSITY

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Abstract: Teaching Mathematics at the university level is not an easy job due to technological development and the needs of students in the 21st century. The rate of completion of all the papers in Mathematics at the university level also seems low in the Nepali context. This might be the cause of a mismatch between the expectations of the teachers and the learners. This work aims to identify the expectations of the learners from teachers in learning Mathematics at colleges. In our qualitative survey, all the students of undergraduate Mathematics programs of Mid-west University constitute the population for the study. The undergraduate program of Mid-West University is of four years with eight semesters, although the odd or even semesters run correspondingly every six months due to the annual new admission system. Altogether five students from each semester are selected randomly as the sample of this study. A semi-structured questionnaire is a tool for gathering information. I have described the information thematically with statistical and pictorial representations as needed. On the basis of the participants' responses, it is concluded that the learners expect basic information, definitions, formula, and relations before starting a new lesson in Mathematics. Also, the learners expect motivation, support, a clear concept as well as the opportunity to practice and discuss in the classroom to learn Mathematics effectively. In my perspective, this paper will be useful to the Mathematics teachers at the university level as well as the school level to teach Mathematics on the basis of the learners' expectations.

Keywords: Clear concept; Expectations; Learning mathematics; Motivation and support

MODELING TWO-PHASE BLOOD FLOW DYNAMICS THROUGH ARTERY ALONG WITH STENOSIS

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Abstract: Blood contains plasma as a fluid and other blood cells as solid particles. Blood flow in capillaries is necessary and blocked flow puts human lives at risk. Deposition of fatty particles in the inner wall of the artery gradually reduces the lumen. The thick and hard layer is called stenosis which ultimately blocks the blood flow. This increases the importance of the study of blood flow. Major factors affecting the blood flow are wall shear stress, viscosity, percentage of hematocrit, size of the artery, *etc*. Mathematical modeling of blood flow incorporates all these factors and tries to explain the blood rheology. In past, there are several attempts to study blood flow using a two-phase model. However, the majority is with treating blood effectively as a single phase. The principal difference compared with a two-phase model to a single-phase model is the appearance of the volume fraction for each phase, as well as mechanisms for the exchange of mass and momentum between the phases at the interfaces. Here we present some existing models for blood flow with and without stenosis and curvature effects. The inclusion of the non-Newtonian stress and virtual mass effects will also be a future focus for further improvement of the existing model.
Keywords: Blood flow models; Stenosis; Curvature effect

A COUPLED AND MULTISCALE MODELING OF MIXTURE MASS FLOWS

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Abstract: Geophysical mass transports such as landslides, debris flows, and flash floods are some widely observed and extremely destructive natural hazards. There is a need for an appropriate description and efficient simulation of these types of flows. A set of highly non-linear and coupled partial differential equations constitutes the advanced physical-mathematical model. Pokhrel et al. (2019) developed a full-dimensional mixture mass flow model to capture the dynamics of flows. I present depth-averaged model equations for mixture mass flows, and multi-scale modeling and simulation of mixture mass flow consisting of solid particles and the interstitial viscous fluids down inclined channels. This technique combines the full-dimensional simulation in the regions where there are large gradients of the field variables, depth-averaged model equations for relatively smooth flows, and the coupling of these models and their simulations. This coupling strategy keeps most of the basic physics of the flow along with very fast and economic numerical computation. Here, I also present a newly constructed model structure for full dimensional mixture flows, and depth-averaged mixture model for channel flows, their domain-decompositions, appropriate coupling across the interfaces, respective boundary conditions at the interfaces, and boundary conditions for the velocities and pressure at the free and the basal surfaces.
Keywords: Mixture mass flows; Multi-scale modeling; Depth-averaged model

PSEUDOCOMPLEMENTATION ON THE LATTICE OF CONVEX SUBLATTICS OF A LATTICE

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Abstract: By a new partial ordering relation '$\leq$' the set of convex sublattices CS(L) of a lattice L is again a lattice. In this paper we establish some results on the pseudocomplementation of (CS(L); $\leq$). We show that a lattice L with 0 is dense if and only if CS(L) is dense. Then we prove that a finite distributive lattice is a Stone lattice if and only if CS(L) is Stone. We also prove that an upper continuous lattice L is a Stone lattice if and only if CS(L) is Stone.
Keyword: Upper continuous lattice; Pseudo-complementation lattice; Dense lattice; Stone lattice

MODELING OF TRANSMISSION DYNAMICS OF COMMUNICABLE DISEASES WITH YOGA

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Abstract: A mathematical model is developed which describes the dynamics of communicable diseases under the assumption that Yoga Pranayama produces immunity power. These immunity powers protect us from infection and re-infection and immune protection may wane over time. The population is divided into naïve Susceptible and Yoga Sadaka susceptible. A scheduled package of pranayama through yoga classes and yoga *shibir* is considered as a disease control strategy. A distinction is made between infection in naive individuals and infection in Yoga Sadhaka individuals. The immune system has been primed by Yoga Pranayama. The association between the prevalence of infection and immunity induced by Yoga Pranayama is analyzed. The model shows that the prevention of diseases depends on the parameters we have developed.
Keywords: Transmission dynamics; Communicable diseases; Yoga; Immunity; Pranayama

RECENT DEVELOPMENTS IN DISCRETE FRACTIONAL CALCULUS

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Abstract: In this talk, fractional discrete calculus is introduced from its basics, its developments over the years and its applications are discussed. Some unusual results like the positive fractional derivative of a function does not always mean it is an increasing function will be discussed.
Keywords: Discrete fractional calculus; Delta and nabla difference; Gamma function

A MATHEMATICAL STUDY OF THE CAR-FOLLOWING MODEL UNDER DIFFERENT TRAFFIC FACILITIES AND ROAD CONDITION

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Abstract: The topic of car-following has become of increased importance in traffic engineering and safety research. The car-following models describe the interaction between adjacent vehicles in the same lane. The car-following model controls the motion of the vehicles in the network, which are being introduced as a driver safety aid in an effort to mimic driver behavior. In the car-following models, the following vehicle must continuously adjust its distance from the leading vehicle to avoid the collision in real-time. The heterogeneity of driver's sensitivity reproduces the effects on speed, acceleration, emission, and fuel consumption of each vehicle. In this work, we observe and analyze the velocity and acceleration profile of the vehicles using the modified car-following models under different traffic facilities and road conditions through the simulated results.
Keywords: Car-following model; Following vehicle; Leading vehicle; Driver's sensitivity

BIFURCATION ANALYSIS OF MALARIA TRANSMISSION MODEL: ROLE OF CROSS-BORDER MOBILITY IN ITS ELIMINATION

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Abstract: Multiple endemic equilibrium points in a model may imply the existence of backward bifurcation. In such cases, malaria persists in the population even though the basic reproduction number is less than 1, needing to formulate another new threshold, such as the transmission threshold, to assert malaria elimination. Therefore, bifurcation analysis is essential for countries like Nepal that are in the malaria elimination phase to ensure the level of control strategies is above the transmission threshold leading to the successful elimination of malaria. Our analysis shows that cross-border mobility can exhibit the phenomenon of backward bifurcation even if the disease-induced death rate is zero. Our result on the role of cross-border mobility further advances from the previous understanding that the disease-induced death rate is the primary driver of backward bifurcation.

Keywords: Endemic equilibrium point; Backward bifurcation; Forward bifurcation; Transmission threshold of malaria

A MATHEMATICAL MODEL FOR TRANSPORT AND GROWTH OF MICROORGANISMS IN UNSATURATED POROUS MEDIUM (SOIL)

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Abstract: We develop a mathematical model for the transport and growth of microorganisms by natural (rain) water infiltration and flow through unsaturated porous medium soil along the vertical direction under gravity and capillarity by coupling a system of advection reaction-diffusion equation for concentration of microorganisms and their growth-limiting substrate with the Richards equation governing flow in unsaturated porous medium and solve it numerically by using different time-stepping schemes and compare their performance.

Keywords: Unsaturated porous medium; Transport of microorganisms; Richards equation; Substrate transport

INFLUENCE OF FRICTION ANGLES ON EARTH PRESSURES IN DRY GRANULAR FLOW DYNAMICS AND SOIL MECHANICS

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Abstract: Natural events like avalanches, debris, mudflows, granular flows, and landslides are also physical problems of the real world occurring regularly in mountainous regions on our globe. The Savage-Hutter model is applied to describe gravity-driven granular material in inclined channels of parabolic-like shapes. Many works have already been done in Savage-Hutter model. The earth pressure coefficient (K) determines the nature of (tendency of) deformation of the granular mass during flow or deposition. When flow velocity is increasing, $K = K_{act}$, and the flow is divergent, and when the velocity of flow is decreasing, then $K = K_{pas}$ and the flow is convergent. The earth pressure is at rest if the wall is in its natural position. The mathematical relations presented here and their 2-D and 3-D plots underline that the passive and active earth coefficients strongly depend on the internal angle ϕ and basal angle δ of frictions. The mathematical relation for dry granular mass flow is extended to find these coefficients in soil mechanics. Active earth pressure drops as the internal angle of friction increases, but passive earth pressure rises.
Keywords: Earth pressure coefficient; Active earth pressure; Passive earth pressure; Internal friction angle; Basal friction angle

NEW CONCEPTS ON R_1 FUZZY SOFT TOPOLOGICAL SPACES

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Abstract: In this paper, we have introduced and studied some new notions of R_1 separation axiom in fuzzy soft topological spaces by using quasi-coincident relation for fuzzy soft points. We have observed that all these notions satisfy good extension property. We have shown that these notions are preserved under the one-one, onto and FSP continuous mapping. Moreover, we have obtained some other properties of this new concept.
Keyword: Fuzzy soft set; Fuzzy soft topological spaces; Fuzzy soft R_1 separations; Initial soft topology; Final soft topology

SEPARATION AXIOM (HAUSDORFF) ON SUPRA FUZZY BI-TOPOLOGICAL SPACE

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Abstract: Four new definitions of Hausdorff (T_2) supra fuzzy bi-topological (pairwise) space have been defined and implications among them have been studied with appropriate counter examples. Subspace and product space of pair wiseT_2 supra fuzzy bi-topological spaces have been discussed with proofs. Mappings between two T_2 supra fuzzy bi-topological (pairwise) spaces have been shown.

Keywords: Suprafuzzy bi-topological space; Supra fuzzy T_2bi-topological Space; Good extension; Hereditary, Productive and projective properties

TWO-LAYERED BLOOD FLOW WITH MILD 2 STENOSIS

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Abstract: The effect of asymmetric mild stenosis on the flow of blood as Newtonian fluid in an artery is studied with some boundary conditions. The formation of stenosis in the arterial lumen disrupts the normal flow which leads to a reduced amount of flow and causes arterial disorders. Blood has been represented by a two-layered fluid consisting core layer of suspension of all erythrocytes and a peripheral layer of plasma. Using appropriate boundary conditions, an analytical expression is constructed in order to examine the variation of velocity profile and volumetric rate for a two-layered model. The study is based on theoretical consideration and numerical evaluation.

Keyboard: Mild stenosis; Newtonian fluid; Arterial lumen; Core layer; Volumetric rate

MATHEMATICAL LITERACY AND PROBLEM-SOLVING ABILITY

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Abstract: Mathematical literacy is taken as a vital construct to be a successful person in the mathematical area. This study aims to explore the relationship between mathematical literacy and the problem-solving ability of grade eight students. The survey was conducted with 271 students using a survey questionnaire from a school in Kathmandu in grade eight. Out of 271 respondents, I had selected high achiever 10, middle achiever 10, and low achiever 10 papers using a stratified random sampling method. The grounded theory approach had used to analyze the data of the study and the result had drawn for good problem-solving ability is found with a strong mathematical literacy foundation.

Keywords: Mathematical literacy; Problem-solving ability; Fundamental knowledge of mathematics

THE FRACTIONAL WAVE EQUATION FOR A VIBRATING STRING

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Abstract: Fractional Calculus is one of the emerging subjects in the present century in which numerous researches have been carried out. It is widely used in all spheres of academic research. Fractional calculus has a long and very interesting history in the field of mathematics and physics with many practical applications. Here, we introduce the solution of a general time-fractional wave equation for a vibrating string and it is also obtained in terms of the Mittag–Leffler-type functions and the complete set of Eigen functions of the Sturm-Liouville problem. The time-fractional derivative is calculated in the Caputo sense, and the problem is solved using the separation of variables approach and the Laplace transform method. Riemann-Liouville derivatives with the Caputo fractional derivatives are also compared with the classical derivatives through MATLAB by finite difference method.

Keywords: Fractional calculus; Mittag–Leffler; Sturm–Liouville; Caputo; Riemann-Liouville; Finite difference

REDEFINITION OF FUZZY LINEAR SPACE

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Abstract: We give some preliminaries regarding fuzzy fields and fuzzy linear spaces. Thereafter, we redefine fuzzy linear space by dropping one condition from the definition given by S. Nanda. Finally, with this definition, we prove that the inverse image of a fuzzy linear space is again a fuzzy linear space.
Keywords: Fuzzy field; Intuitionistic fuzzy set; Inverse image; Membership function of fuzzy set; Non-membership function

STUDY OF BREAST TISSUE TEMPERATURE AT DIFFERENT AGES OF TUMOR

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Abstract: Tumor is characterized by the abnormal and uncontrolled growth of cells due to some physical and chemical factors. Breast tumors develop inside the mammary glands of the breast. When a tumor grows, it needs more nutrition. So, blood perfusion and metabolism are higher in tumors than in normal tissues. This causes the temperature to rise in the in-vivo breast tissue. The size of a tumor is determined by the tumor age. In this work, the finite element method (FEM) is used to solve the two-dimensional bio-heat equation to find the temperature distribution in the breast tissue at different ages of a tumor. The results show that the blood perfusion and metabolic rate play important roles to determine the temperature of a breast tumor.
Keywords: Breast tumor; Temperature; Tumor age; Bio-heat equation; FEM

MECHANICS OF LOVE

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Abstract: This work deals with the Mechanics of love in an interpersonal relationship. Robert Sternberg's theory describes types of love based on three different scales: intimacy, passion, and commitment. We will try to recognize that a relationship based on a single element is less likely to survive than one based on two or more mathematically. In fact, relationship dynamics are the patterns of behavior that happen between people in ways. We relate, interact and communicate with each other. We find the result as no need for suicide in the case of love affairs.
Keywords: Love; Responsibility; Dynamics; Relationship

TEACHING MATHEMATICS EDUCATION TO NEPALI LEARNERS IN A BLENDED LEARNING APPROACH

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Abstract: The purpose of this writing is to share the author's experience of using the blended approach to teaching mathematics in the Nepali context. There is increasing national concern about the academic accomplishment of Nepali mathematics learners. National and international studies have justified that the implication of mathematics education in blended learning approaches has been alarmingly supportive in the new normal. The extent of motivation by the facilitators, learners in the e-classroom, concepts of mathematics teaching, giving assignments, and evaluation have proved to be important during the pandemic and new normal too. The emotional aspects of teaching mathematics to the particular situation during the pandemic seemed significant. Teaching mathematics at a distance is related to the fact that, at the higher education level, the facilitators generally teach mathematics in a formal way using mathematical symbols and formulas. Again, the way of teaching mathematics depends upon the learners to whom the teaching is addressed. This work explores that teaching mathematics in a blended learning approach guides the learners in fruitful directions as they sort out details and experience connections for themselves. The study results show that the attitude of the mathematics teachers at the tertiary level towards using ICT tools in terms of behavioral engagement and confidence is positive. However, in the new normal, they lose some specific knowledge in embedding technological tools in order to make the physical classroom more lively and fruitful.
Keywords: Mathematics; Teaching; Blended learning approach; Assessment; New normal; ICT tools; 5Es; Constructivist; Behaviorist

TRANSFORMATIVE LEARNING AND IDENTITY CHANGE

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Abstract: The agenda of this presentation is to reveal the role of transformative learning for identity change in teaching. Transformative learning is the fundamental change in the old habit of mind, values, and belief systems. In the teaching process, transformative learning is an ongoing process to conquer the conventional prevalent teaching method so far. It profounds change that develops the capacities for reforming at various levels by transforming the persons and their identities through questioning the prevalent belief systems. We have attempted to visualize the process of conquering the conventional teaching-learning method of mathematics to bring about change in our personal selves. As identity is a dimension for self-confidence, self-understanding, and self-realization, how exactly transformative learning brings a change in identity becomes the major concern here? To address this gap, our purpose is to share the identity change through the role and theories of transformative learning. We have highlighted Kund Illereris and Drix's theory and its ranges. This presentation lands with an implication that transformative learning and identity are interrelated for bringing a change in a person from the individual level to professional well-being.

Keywords: Transformative learning; Conventional method; Transformative learning theory; identity change

APPLICATION OF FIXED POINT IN ORDINARY NON-LINEAR DIFFERENTIAL EQUATIONS

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Abstract: Fixed point theory is one of the most important tools for proving the existence and uniqueness of the solution for various mathematical models such as ordinary and partial differential equations. Since 1922, the well-known Banach fixed point theorem is an extremely applicable theory in the field of fixed point theory. The purpose of this paper is to study the concept of fixed point with its geometry and elaborate on this concept while solving non-linear differential equations together with introducing the Jacobian matrix. We will also test the stability of the solution with the help of eigenvalues

Keywords: Fixed point; Differential equations; Jacobian matrix; Eigenvalue; Stability of solution

COMMON FIXED POINT THEOREM FOR THREE PAIRS OF MAPPING IN SEMI-METRIC SPACE USING ∅-CONTRACTION

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Abstract: Fixed point theory in semi-metric space is one of the emerging areas of interdisciplinary mathematical research. It plays a crucial role in nonlinear functional analysis. S. Banach published his contraction principle in 1922. Since then, this principle has been extended and generalized in several ways in semi-metric space. Among these, one such generalization is formulated in semi-metric space initiated by M. Frechet, K. Menger, and W.A. Wilson. In 1976 M. Cicchese introduced the notion of a contractive mapping in semi-metric space and proved the first fixed point theorem for this class of spaces. The purpose of this paper is to establish a common fixed point theorem for three pairs of mappings in semi-space metric space using ∅-contraction.
Keywords: Semi-metric space; Compatibility; Weakly compatible; Fixed point; Common fixed point

LEARNING MATHEMATICS CONNECTION IN WEAVING PATTERNS OF BAMBOO ARTIFACT, CHALNO: EXPERIENCES ON SECONDARY LEVEL STUDENTS OF A PRIVATE SCHOOL IN NEPAL

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Abstract: The main purpose of this work is to explore the experiences of secondary level students in learning mathematics based on ethnomathematics and ethnomodelling using the weaving patterns of bamboo artifacts, *chalno*. The design of this study involved a critical interpretive qualitative approach. The information was collected from 15 purposively selected students studying in grades nine and ten in the academic year 2078–2079 in the Pokhara valley. Information was collected through distributed artefact patterns, participant observation, interviews, and in-depth individual and group discussions. The interviews were audio-recorded and transcribed for coding. Then the themes were generated. The major themes that emerged were, *chalno* patterns and holes: beautiful manipulative materials for a holistic approach of learning sequences and series modeling through non-use and use of the GeoGebra software; single artifact but generated multi-contents and multi-lessons in mathematics; and sequence and series of patterns of holes: single and composite transformation, formulae, and graph hold. The findings will be presented thematically. The study finds that integration of the aforesaid manipulative single *chalno* helped students to learn geometry (circle, transformation, triangle, and parallelogram concepts), sequence and series (Algebra) in grades ten and nine, and graph-related problems as the web of spider approach in a creative and fast way, working collaboratively through research-based. The findings of this study could be helpful to both teachers, students, and teacher educators to learn and teach various lessons of multi-content by blending technology and cultural heritage such as bamboo artifacts. The study also adds to the literature for teaching and learning mathematics in similar areas.
Keywords: Learning; Multi-contents; Bamboo artifact; Ethnomathematics; GeoGebra software

ARTIFICIAL NEURAL NETWORK-GENETIC ALGORITHM FOR OPTIMIZATION OF MULTIVARIATE FUNCTION: AN APPLICATION TO LACTIC ACID PRODUCTION

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Abstract: In the scientific work with the experimental procedure, it is essential to establish a relationship between factors affecting a process and the outputs of that process. Additionally, out of all possible factors, one needs to estimate the best possible factors that optimize the output. The relation between the factors and output is modeled by Artificial Neural Network (ANN) to develop a functional relation. The meta-heuristic Genetic Algorithm has been used for the optimization of the ANN modeled function. For the validity, the ANN model is used to construct a known multivariate function and finally, GA is applied to estimate its optimal value. Finally, this approach is applied for the optimization of lactic acid production. Finally, this approach is used to optimize the experimental conditions for the fermentation of lactic acid.
Keywords: Optimization; ANN; GA; Lactic acid

HIGHER-ORDER THINKING SKILLS: AN INVESTIGATION OF HIGH SCHOOL MATHEMATICS BOARD EXAMS IN NEPAL

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Abstract: Higher-order thinking skills (HOTS) that help students think critically and enable them to solve real-world problems are emphasized in the mathematics curriculum of many nations. However, assessment practices do not always seem to be aligned with curricular goals. Exams are indicators of what is valued and have the potential "washback effect" on the teaching and learning of mathematics. Therefore, it is important to understand how HOTS are being assessed in exams and other forms of assessment. In an attempt to do so in the context of Nepal, we analyzed mathematics board exams of grades XI and XII from the last fifteen years. We used the revised Bloom's taxonomy as a framework to categorize exam questions. Preliminary results show that there is a scarcity of HOTS questions, and an overwhelming majority of the problems just tested lower-order thinking skills (LOTS). Results also show that most of the exam questions can be solved by mimicking the examples and exercise problems given in the textbooks and practicing those problems that have appeared in previous board exams. We will discuss the significance of the findings in relation to the teaching and learning of mathematics in Nepal.
Keywords: Higher-order thinking skills; Mathematics teaching; Assessments; Washback effect

A STUDY ON RELATIONS BETWEEN COMPLETENESS AND COMPACTNESS IN FINITE-DIMENSIONAL FUZZY NORMED LINEAR SPACE

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Abstract: In this work, we introduce continuous *t*-norm and continuous *t*-co-norm. We first establish necessary and sufficient conditions for a subset to be compact. An attempt is made to deal with some important results involving completeness and compactness of finite-dimensional fuzzy normed linear spaces.
Keywords: Boundedness; Fuzzy norm; Intuitionistic fuzzy normed linear space; *t*-norm; *t*-co-norm

ON CERTAIN TYPES OF DIFFERENCE SEQUENCE SPACES DEFINED BY φ-FUNCTION

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Abstract: So far a large number of research works have been studied and investigated in basic sequence spaces. In the present work, we introduce the difference sequence spaces $W_0(\Delta, f)$, $W(\Delta, f)$ and $W_\infty(\Delta, f)$ defined by non-negative real valued φ-function on the set of real numbers and study some of their topological properties defined by the paranorm structure on these spaces.
Keywords: Sequence spaces; Difference sequence spaces; Paranormed space; Orlicz function; Normal space

A TRAFFIC FLOW MODEL: IMPACT OF MOTORBIKES FOR CONGESTION MINIMIZATION

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Abstract: Separate lanes for bikes and vehicles are made nowadays in many urban streets. However, when the flow of bicycles is large then it would occupy the vehicle lanes and thus resulting in traffic congestion. Modernization and urbanization have increased the economic standard of people because of which motor vehicles have become the major aspects of clothing, food, housing, and transportation. The number of motorbikes is increasing day by day in the urban areas of Nepal which in turn causes problems for both the bicyclist and the car drivers. Since the cyclists limit the road capacity for the car drivers, it results in traffic congestion. Traffic congestion is a condition in transport that is characterized by slower speed, longer trip times, and increased vehicular queuing. Interaction between vehicles slows the speed of the traffic stream when the traffic density is high and this results in congestion. When the demand approaches the capacity of a road, extreme traffic congestion results. When vehicles are fully stopped for particular periods of time, then the condition is called a traffic jam. The primary objective of this study is to know how the impact of bicycle on congestion minimization is, and the secondary aim is to extend the LWR model for the case of non-homogeneous traffic in urban culture to the context of extreme congestion. The cumulative curve is designed to obtain the relationship between the vehicular density and their speeds.

Keywords: Traffic flux; Traffic congestion; Traffic variables

REACTION-DIFFUSION SYSTEM AND PATTERN FORMATION

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Abstract: We review the development of the concept of reaction-diffusion leading to pattern formation in living organisms. The article commences with historical background and then describes biological development and ideas of the formation of patterns using dynamic activator-inhibitor systems. In addition to this, different models to represent such systems are discussed and their computer simulations are presented.

Keywords: Diffusion; Reaction; Inhibitor; Activator