



**RADMAS– 2016**

## BULLETIN OF MATHEMATICS AND STATISTICS RESEARCH

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### **Keynote Address**

#### **RECENT ADVANCES IN MATHEMATICS AND ITS APPLICATIONS**

**Prof. P.S. AVADHANI,**

Principal, AU Engineering College (A), Visakhapatnam

The advances in Information Technology, Biotechnology, Space technology, Nano-Technology and others have really brought in many advancements in field of mathematics. Especially, the exponential growth in the information technology and the issues it has raised have necessitated many advancements in mathematics. The idea of this article is to discuss some recent advances in mathematics which have contributed to good number of applications.

**Number Theory:** It is one of the most interesting subjects in the field of mathematics. Earlier people were always of the impression that number theory has no applications. However, it is widely used in Cyber Security. The concepts of primality testing, discrete logarithms and Pell's Equation have proved to be very much useful in encryption and decryption processes.

**Abstract Algebra or Modern Algebra:** Normally, any security system needs to provide some sort of confusion, diffusion and entropy in their data and processes. Commutativity and Associativity are two fundamental concepts which often provide some sort of regularity of any structure. The algebraic structures which defy these properties are very much useful in providing the concepts of confusion and diffusion.

**Graph Theory:** This is one of the very important areas of mathematics which has wide range of applications in the recent developments. The graphs isomorphism problem has been useful in zero knowledge protocols which are used for authentication.

**Elliptic Curves:** The subject of elliptic curves is another important topic which is proved to be very useful in providing authentication and confidentiality in communications.



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**Invited Talk**

### **EXISTENCE OF FIXED POINTS/ COMMON FIXED POINTS OF VARIOUS TYPES OF CONTRACTION MAPS**

**G. V. RAVINDRANADH BABU**

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We discuss contractions, weakly contractive maps, weak contractions, Condition (B), generalized condition (B) and the existence of fixed points of these maps in complete metric spaces. Further, we extend our discussion to a pair of maps by defining 'generalized condition (B) with respect to a pair of selfmaps'. On the other hand, we define 'generalized weakly contractive condition with respect to a pair of maps' and discuss the existence of common fixed points. Now, by combining the concepts of maps satisfying 'Condition (B)' and 'generalized weakly contractive condition with respect to a pair of maps', we introduce 'generalized almost weakly contractive condition for a pair of selfmaps' and study the existence of common fixed points.

**Invited Talk**

### **MODELING TRANSPORT PHENOMENA INSIDE DEFORMABLE TUMOURS USING MIXTURE THEORY**

**G P RAJA SEKHAR**

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The talk focuses on modeling fluids and macromolecule transport inside a solid tumor. Most of the soft biological tissues show materialistic properties similar to deformable porous material. They exhibit mechanical behavior towards the fluid motion since the solid phase of the tumor tissue gets compressed by the drag force that is associated with the extracellular fluid flow. The talk first introduces the structure of a tumor and various barriers involved to fluids and macromolecule transport. The talk then introduces mixture theory and the corresponding governing equations modelling deformable porous media. These hydrodynamic equations will be used to model flow through an isolated tumour (in vitro mimicking model) and tumour surrounded by a normal tissue (in vivo mimicking model). We propose suitable criteria for the formation of necrosis within the tumor interstitium. This study introduces some parameters that represent the nutrient supply from tumor blood vessels into the tumor extracellular space. These transport parameters compete with the reversible nutrient metabolism of the tumor cells present in the interstitium. The present study also discusses the dependency of effectiveness factor on various parameters. Finally, the talk ends with some remarks on flow inside glycocalyx layer.



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**Invited Talk**

**FIXED AND COMMON FIXED POINT THEOREMS IN PARTIALLY ORDERED METRIC SPACES WITH RATIONAL TYPE EXPRESSIONS**

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We prove the existence of fixed points of  $\psi$ -weak generalized Geraghty contractions [1] and also, we prove the existence of common fixed points for a pair of self maps of  $\psi$ -weak generalized Geraghty contraction in partially ordered metric spaces [2]. We prove the existence of common fixed points for a pair  $(f, g)$  of weak generalized  $(\alpha, \psi)$ -contractive maps with rational expression [4], and also we study the existence of fixed points of self-maps in partially ordered metric spaces with control functions  $\phi$  and  $\psi$  involving rational type expressions [5].

We establish the existence of coincidence points for a pair of self maps on a partially ordered metric space, satisfying a contractive condition with rational expressions [6]. We also investigate conditions for the existence and uniqueness of fixed points. We provide examples to illustrate the importance of the hypotheses that are used to prove our main results. These results extend and generalize some of the known results that are available in the literature.

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### Invited Talk

#### APPLICATION OF THE INFIMUM PROPERTY TO FIXED POINT THEOREMS

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Suppose that  $X$  is a nonempty set and  $f$  denotes a self-map on  $X$ . A point  $p \in X$  is a fixed point of  $f$ , if  $fx = x$ . A set of conditions on  $f$  and  $X$  which ensures a fixed point of  $f$  is known as a fixed point theorem. Fixed point theorems are useful in problems of existence and uniqueness of the solutions of certain differential and integral equations in physical, engineering and other optimization problems.

Iterative procedure is usually employed in proving fixed point theorems. Given a self-map  $f$  on  $X$  and  $x \in X$ , researchers show that the successive  $f$ -iterates  $fx, f^2x, \dots$  converge to some  $p \in X$ , which will be a unique fixed point. For the first time, Joseph and Kwack [1] in 1999 obtained a fixed point in a metric space without using the iterations. In fact, they used the triangle inequality of the metric  $d$  and the well-known greatest lower bound property of real numbers. This idea has been extended to find fixed points for Banach and Kannan type contractions in a  $G$ -metric space by Phaneendra and Kumara Swamy [2] in 2013. This technique is mainly useful in finding  $G$ -contractive fixed points.

Some analytical proofs are presented in this talk under various contraction conditions for obtaining fixed points and hence  $G$ -contractive fixed points in  $G$ -metric space. An aspiring research can broaden the view of fixed point theorems in other metrical structures also.

**2010 AMS Mathematics Subject Classification:** 54 H 25

**Key Words:** The infimum property,  $G$ -Cauchy sequence, Fixed Point,  $G$ -Contractive fixed point

#### Main References

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### Invited Talk

#### SOME UNSOLVED PROBLEMS IN THEORY OF NUMBERS

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Visakhapatnam -530045

We discuss some unsolved problems in theory of numbers involving basic arithmetic functions such as the sum of the divisor function, Euler's  $\phi$ -function and their unitary analogues. For example, we present conjectures such as Carmichael's conjecture, D.H.Lehmer's conjecture and  $3x+1$  conjecture etc

### Invited Talk

#### INTERESTING RESULTS IN METRIC FIXED POINT THEORY AND APPLICATIONS

**PENUMARTHY PARVATEESAM MURTHY**

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Abstract. Motivation of this talk is due to Brouwer's Fixed Point Theorem, Banach Fixed Point Theorem(S. Banach, Surles operations dans les ensembles abstraits et Leur application aux equations integrales, *Fund. Math.*3(1922), 133-181.(French)) and Kannan's Fixed Point Theorem( R. Kannan, Some Results of Fixed Points, *Bull. Cal. Math. Soc. Proc.* 60(1968), 70 - 78., Gregus Fixed Point Theorem(M. Gregu\_s, A \_xed point theorem in Banach Spaces, *Buu. Univ. Math. Ital.* 17(A), 193-198,1980). I am highly inspired by the of the researchers mentioned above. Also interested to discuss how the fixed point theory gown up since its initial stage to till now in terms of some conditions imposed on the hypothesis of the theorems for obtaining fixed and common fixed points. Most general result in this area was due to Brouwer.

**2000 Mathematics Subject Classi\_cation.** 47H10, 54H25.

**Key words and phrases.** Contraction map, Contractive map, Non-expansive map, contraction, weak  $\phi$  contraction,  $(\phi; )$ -Weak Contraction, Greguš Type Condition, Saks Spaces, Complex Valued Metric Spaces, etc.



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### Invited Talk

#### TRAPDOOR SYSTEMS WITH POLYNOMIALS

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The development of public key cryptography is due to Diffie and Hellman given in 1976 with the idea based on using one way functions or one way trapdoor functions. The RSA cryptosystem is the first Public key cryptosystem, based on one way trapdoor function. As trapdoor functions are hard to find, search for algebraic systems with trapdoor property of RSA gained importance. In this paper we describe the trapdoor property on the group of units of the ring  $\frac{\mathbb{Z}_p[x]}{(f(x))}$  and the construction of trapdoor system for any polynomial  $(f(x)) \in \mathbb{Z}_p[x]$ .

### Invited Talk

#### MECHANICS OF BREAKOUT PHENOMENON WHILE LIFTING A LARGE OBJECT FROM AN ANISOTROPIC POROUS BED

**G P RAJA SEKHAR**

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The talk consists of two parts. Part-I of the talk introduces elementary interpretations on governing equations and boundary conditions in a generic sense with respect to viscous incompressible fluid flow and then corresponding governing equations for flow through porous media will be given. The boundary conditions will be classified as boundary conditions at a (i) rigid impermeable boundary, (ii) fluid-fluid interface, and (iii) porous-liquid interface. This talk describes in brief widely used analytical techniques with simple examples, say, separation of variable solution for the stream function, complex potential method etc.

With a fair understanding of the governing equations and the interface conditions, part-II of the talk presents an application involving flow through porous media, namely, mechanics of break-out phenomenon while lifting a large object from an anisotropic porous bed. An analytical study of two dimensional problem of lifting an object from the top of a fully saturated rigid porous bed is discussed. It is assumed that the porous bed is anisotropic in nature. The flow within the gap region between the object and the porous bed is assumed to be governed by Stokes equation while the flow within the porous bed is governed by Brinkman equation. The breakout phenomenon for different kinds of soil is reported. The effect of mechanical properties like anisotropic permeability, grain diameter size and porosity on streamlines, velocity and force is analyzed. This work has application in salvaging of sunken ships, moving object at offshore, submersible engineering etc.