CUP-IISERM MATHEMATICS GRADUATE STUDENT WORKSHOP

ABSTRACT BOOKLET

December 15, 2020

Speaker: Ankit Yadav, CUP Bhatinda.
Title: *A study on the geometry of light like submanifolds.*
Abstract: Our approach through this talk is to elaborate the origin of light like geometry by giving mathematical and geometrical explanation. Further, we will discuss some important applications of light like geometry which are being widely studied in the field of Astrophysics and Mathematical Physics. After giving a brief explanation about light like geometry and its applications, we will explore some important work which we have carried out in the field of light like geometry. Precisely, we will focus on study of submersion on light like submanifolds.

Speaker: Divya Jyoti, CUP Bhatinda.
Title: *Exact solutions of Einstein field equations.*
Abstract: The exact solutions of the Einstein field equations (EFEs) are useful in understanding the geometry of the stellar objects. So, obtaining exact solutions of EFEs is very important. In our work, the exact non-static solutions of EFEs in perfect fluid distribution are obtained with the use of Lie symmetry approach. Firstly, the EFEs in perfect fluid distribution are obtained, in correspondence to a non-static semi-Riemannian metric in Cartesian coordinates. Then, the EFEs, in the form of partial differential equations, are further reduced into ordinary differential equations by using classical Lie symmetries. The obtained exact solutions belong to a curved space-time in a gravitational field of Petrov type D. Also, the Ricci tensor components are obtained in cylindrical coordinates for the EFEs in vacuum, in a gravitational field of Petrov type I.

Speaker: Kirandeep Kaur, CUP Bhatinda.
Title: *On the flag curvature of a homogeneous Finsler space with an invariant metric.*
Abstract: In this paper, we study flag curvature, which is an important geometric quantity to characterize Finsler spaces. It is very difficult to compute the flag curvature of a general Finsler space as local coordinates are involved in computation. It can be calculated for homogeneous Finsler spaces without using local coordinates. First we derive an explicit formula for the flag curvature of a homogeneous Finsler space with infinite series metric. Next, we deduce it for naturally reductive homogeneous Finsler space with the above mentioned metric.

Speaker: Baljinder Kour, CUP Bhatinda.
Title: *Symmetry analysis and conservation laws of space time fractional partial differential equation.*
Abstract: In this study, the Lie symmetry method is successfully applied to investigate the symmetries of system of space-time fractional partial differential equations. With the help of the obtained symmetries, the governing system is reduced into the system of nonlinear fractional ordinary differential equations (NLFODEs) which contains Erdelyi-Kober fractional differential operators via Riemann-Liouville fractional derivative. There is a one to one correspondence between symmetries and conservation laws of a physical phenomenon, so the conservation laws of the governing system are constructed by using the new conservation theorem and generalization of the Noether operators.

Speaker: Kanika Singla, IISER Mohali.
Title: *Splittings of Differential Central Simple Algebras.*
Abstract: Lourdes and Magid gave a new direction to the theory of Differential Central Simple Algebras (DCSAs) by exhibiting a Picard-Vessiot extension of the ground field that splits a given DCSA. In this talk, the splitting of certain types of DCSAs by algebraic extensions of the underlying differential fields will be discussed. Certain cases of transcendental extensions splitting a given DCSAs will also be discussed. This is a joint work with Dr. Amit Kulshrestha.

Speaker: Neha Nanda, IISER Mohali.
Title: *Doodles on surfaces and its related groups.*
Abstract: Study of certain isotopy classes of a finite collection of immersed circles without triple or higher intersections on closed oriented surfaces can be thought of as a planar analogue of virtual knot theory where the genus zero case corresponds to classical knot theory. Alexander and Markov theorems for the genus zero case are known, the role of groups is played by twin groups, a class of right-angled Coxeter groups with only far commutativity relations. In the talk, Alexander and Markov theorems for higher genus case, where the role of groups is played by a new class of groups called virtual twin groups, will be discussed which is work in collaboration with Dr Mahender Singh. Furthermore, recent work on structural aspects of these groups will be addressed which is a joint work with Dr Mahender Singh and Dr Tushar Kanta Naik.

Speaker: Amit Roy, IISER Mohali.
Title: 1-*skeleton ideal of a graph.*
Abstract: Let G be a (multi) graph on the vertex set $V = \{0, 1, \ldots, n\}$ with root 0. The G-parking function ideal $\mathcal{M}_G$ is a monomial ideal in the polynomial ring $R = \mathbb{K}[x_1, \ldots, x_n]$ over a field $\mathbb{K}$ such that $\dim_{\mathbb{K}} \left(\frac{R}{\mathcal{M}_G}\right) = \det\left(\widetilde{L}_G\right)$, where $\widetilde{L}_G$ is the truncated Laplace matrix of G. In other words, standard monomials of the Artinian quotient $\frac{R}{M_G}$ correspond bijectively with the spanning trees of G. For $0 \leq k \leq n-1$, the k-skeleton ideal $\mathcal{M}_G^{(k)}$ of G is a monomial subideal $\mathcal{M}_G^{(k)} = \langle m_A : \emptyset \neq A \subseteq [n] \text{ and } |A| \leq k+1 \rangle$ of the G-parking function ideal $\mathcal{M}_G = \langle m_A : \emptyset \neq A \subseteq [n] \rangle \subseteq R$. In this talk we will focus on the 1-skeleton ideal $\mathcal{M}_G^{(1)}$ of a graph G and see how the number of standard monomials of $\frac{R}{\mathcal{M}_G^{(1)}}$ is related to the truncated signless Laplace matrix $\widetilde{Q}_G$ of G. This is based on joint work with C. Kumar and G. Lather.

Speaker: Shushma Rani, IISER Mohali.
Title: *Combinatorial view point of root spaces of Borcherds Kac-Moody Lie superalgebra* $\mathfrak{g}$.
Abstract: We will define a combinatorial object called Lyndon heaps, which form a basis of free partially commutative Lie algebra. We have a super analogue of this result. We can identify this with root space $\mathfrak{g}(\eta(\mathbf{k}))$ with some conditions on $\mathbf{k}$. Using the super analogue of the above result we will obtain the dimension of this root space. Also using one-one correspondence between spanning set of this root space and basis of free partially commutative Lie superalgebra, we will find basis of this root space of Borcherd Kac-Moody Lie superalgebra..
