INDIAN WOMEN and MATHEMATICS
8,9,10 January, IMSc, Chennai

**Rama Mishra:**

**Title: Polynomials in Knot theory**

**Abstract:** Knots are fascinating objects and more interestingly they are studied mathematically in a subject known as knot theory. In this talk I will discuss how polynomials play a crucial role in the study of knots, be it as invariants for classifying knots or as embeddings for representing them in 3-space.

**Mahuya Dutta:**

**Title: Handlebody decomposition of a manifold**

**Abstract:** A handle of index k and dimension n, by definition, is a manifold with boundary which is diffeomorphic to D^k ? D^{n-k} in R^n , where D^k and D^{n-k} denote balls in Euclidean spaces R^k and R^{n-k} respectively. It can be shown that a compact n dimensional manifold without boundary can be developed from a ball D^n by successively attaching to it finitely many handles of dimension n. This is a fundamental result in Morse theory. We will explain the result by means of examples.

**Usha Bhosle:**
T**itle: Quadrics and vector bundles.**

**Abstract:** The notions of pencils of quadrics, hyperelliptic curves, vector bundles will be introduced. The beautiful correspondence between quadrics and vector bundles will be explained.

**Suneeta Varadarajan**
**Title*:*** ***Found****: Yet another point of intersection between Geometry and Physics*

**Abstract:** In 2003, a Russian mathematician, Grisha Perelman, published a proof of the Poincare conjecture, then one of the most important open problems

in mathematics. Perelman? amazing and insightful proof used a differential equation that represented *a flow through geometries.* In this talk, we will describe this work and then discuss a startling connection of this flow to one of the most important open problems in fundamental physics: how does the geometry of space(time) change in response to the dynamical change of matter in it?

**Riddhi Shah:**

**Title: Dynamics of Distal Group Actions**

**Abstract:** An automorphism $T$ of a locally compact group is said to be distal if
the closure of $T$-orbits of any nontrivial element stays
away from the identity. We discuss some properties of distal actions on groups.

**Nalini Anantharaman:**

**Title: The semiclassical limit for eigenfunctions of the laplacian : a survey.**

**Abstract:** This will be a (non exhaustive) survey talk about the eigenfunctions of
the laplacian in compact domain, in the asymptotic regime where the
eigenvalue goes to infinity. The issue of ``quantum ergodicity'' is to
understand the places where the eigenfunctions can concentrate. I will
also discuss the geometry of nodal lines.

**Preena Samuel:**

**Title: RSK bases in invariant theory.**

**Abstract:**
Invariant theory comes as an efficient tool in studying orbits of spaces under group actions. In this talk we shall look at some classical examples of groups acting on vector spaces and discuss their orbits. We discuss a framework where this geometric question can be posed as an algebraic one, thus

bringing in classical invariant theory into the picture. We then pose our main problem of interest, namely finding the orbits of the action of the general linear group on the space of matrices by conjugation, into this setting. The history of this problem will be briefly discussed and finally, the RSK basis/generators which provide all the information on the orbit structure for this action will be introduced along with a sketch of the proof.

**Geetha Thangavelu:**

**Title: Cellular Algebras**

**Abstract:** Cellular algebras were introduced by Graham and Lehrer in 1996. One of the central problems in the representation theory of finite groups and finite dimensional algebras is to determine the number of non-isomorphic simple modules.

But in the real-world, algebras, especially those with the interesting applications in mathematics and physics, to parametrize the irreducible representations of these algebras is quite a hard problem. One of the strengths of the theory of cellular algebras is that it provides a complete list of absolutely irreducible modules for the algebra over a field. In this talk we will discuss cellular algebras and their applications to algebras in mathematics and physics.

**Archana Morye:**

**Title: Vector bundles over real abelian varieties**

**Abstract:** Holomorphic connections play an important role in the theory of complex vector bundles. But unlike differentiable connection holomorphic connection may not exist at all. In the case of holomorphic bundles over a complex abelian variety, the existence of a algebraic connection is

interlinked with the concept of a stability (semi-stability) of a vector bundle. Moreover it is a class of homogeneous vector bundles. Holomorphic connections in holomorphic bundles over a complex abelian variety were studied by Balaji, Biswas, Gomez, Iyer and Subramanian. In this talk we will give analogues, for real abelian arieties, of some of their results. The statement of the problem will be presented in a way accessible to a wide audience. And finally discuss various equivalent conditions for the presence of real holomorphic connections in a real holomorphic vector bundle over a real abelian variety.

## GROUP LEADERS and GROUP DISCUSSIONS:

**Ranja Roy: (Subject: Topology)**

**Title: Exploring the Euler Characteristic**

**Abstract:** Algebraic Topology is a branch of Mathematics that uses algebraic objects, such as numbers, to study geometric objects called Manifolds. The Euler Characteristic is one such number that we associate to a manifold. In this talk we will discuss briefly the classification of closed 2-manifolds based on Euler Characteristic, and explore the importance of this invariant leading to a specific Euler Characteristic formula in the `Asphericalization of Manifold'

**Usha Mohan: (Subject: Mathematical Modelling)**

**Title: Mathematical Models in Management**

**Rukmini Dey: (Subject: Geometry)**

**Title: Minimal Surfaces**

**Abstract:**

I will introduce minimal surfaces which are surfaces whose mean
curvature =0 with a lot of pictures.
I will explain the Weierstrass-Enneper representation of

minimal surfaces using hodographic coordinates. Then I will explain the
link between minimal surfaces and Born-Infeld solitons. If time permits,
I will explain my on-going work on the interpolation between two real
analytic curves by piecewise minimal surfaces.

**Punita Batra: (Subject: Algebra and representation theory)**

**Title: Lie Algebras**

**Abstract:** I will discuss basics on Lie Algebras.

**Shantha Bhushan: (Subject: Topology and Biology)**
**Topic : Using knot theory in understanding proteins.**
**Abstract:**
The aim of this talk is to present an introduction and overview to the
application of geometry and topology in understanding protein structure and
specifically *knotting of the backbone*.  Various mathematical tools and
techniques have been applied in modeling and solving problems in biology.
We focus on topological tools especially from knot theory that would be
helpful in understanding proteins.

**Preeti Raman: (Subject: Number theory)**

**Title: Hasse principle for algebraic groups**

**Abstract:** We will discuss the classical Hasse-Minkowski theorem for
quadratic forms and explain the Hasse principle for algebraic groups using  Galois cohomology.

**Clare D'Cruz: (Subject: Algebra)**

**Title: Euclid's Algorithm**

**Abstract:** Solving Polynomial equations has been of interest and importance. How do we understand the solution set for these equations ?
Can we extend the ideas of Euclid's method for finding the quotient and remainders, for two given integers, to polynomials.
We will discuss the analogue of Euclid's algorithm for polynomials. If time permits, we will also state its applications.

**Sanoli Gun: (Number Theory)**

**Title: Ramanujan and Transcendence**

**Abstract:** I will discuss some of the contributions of Ramanujan and their effect on modular transcendence theory.