RMS Workshop:
Some High Points of Undergraduate Mathematics Education
Indian Institute of Science Education and Research Mohali
May 14, 2015

ABSTRACTS

(1) **C. S. Aravinda**
TIFR-CAM, Bangalore.

Title: *Polyhedrons, Euler number and Gauss-Bonnet for polyhedrons.*.

Abstract: This talk will be a quick sight-seeing tour starting from tilings of the plane, moving on to Platonic solids, Euler number, topologically regular solids and finishing with the Gauss-Bonnet theorem for polyhedrons. Along the journey, a glimpse into couple of fascinating detours will also be mentioned.

(2) **Harold Edward**
Courant Institute of Mathematical Sciences, New York

Title: *A More Fundamental Theorem of Algebra.*

Abstract: What is called the fundamental theorem of algebra is not a theorem of algebra (complex numbers are not algebraic) and it is not a basic fact of algebra. The solution of the equation $x^3 = 2$ will be developed in a way that illustrates the truly fundamental theorem which states: A splitting field of a polynomial can be constructed algebraically.

(3) **Sudhir Ghorpade**
Indian Institute of Technology Bombay

Title: *Defining π and the trigonometric functions without getting into circles.*

Abstract: A fundamental fact assumed tacitly in high school is that the ratio of circumference to the diameter of a circle is constant regardless of the size of the circle, and moreover this constant is also the ratio of the area of a disc to the square of its radius. It would stand to reason that a high point of undergraduate math education could be to provide a rigorous proof of this fact, once the basic notions of circumference of a circle (or more generally, the arc length of a curve), area of a planar region, are clearly defined using calculus. However, determination of the integrals that give the the circumference and area usually involves the use of trigonometric functions. And the usual "definitions" of these functions of real variables (via the radian measure!) actually presupposes the notion of π. Thus it would seem that one gets into vicious circles. We will

discuss this dilemma and a way out. Along the way, we will also discuss alternative definitions of trigonometric functions and more generally, the elementary transcendental functions, and an algebraic motivation for introducing them. If time permits, we will also discuss a proof of the fact that the elementary transcendental functions are indeed transcendental.

(4) **S. A. Katre**
S. P. Pune University

Title: *Chinese remainder theorem, Lagrange's interpolation formula and partial fractions.*

Abstract: Chinese remainder theorem is studied from ancient times in the number theoretic context, and is seen in the work of Bhaskaracharya in his problems in Bijaganita. We shall highlight how its polynomial analog for linear polynomials leads to Lagrange's interpolation formula and the analog for linear and quadratic polynomials leads to partial fractions used in integration. This connection shows how seemingly different results studied in UG Mathematics can have the same underlying idea.

(5) **Dinesh Khurana**
Panjab University Chandigarh.

Title: *Solutions of the equation $x^d = 1$ in finite groups.*

Abstract: In 1895 Frobenius proved that the number of solutions of $x^d = 1$ in a finite group G is always a multiple of d, where d is a divisor of order of G. This result has many interesting applications in finite group theory. For instance one can characterize all postive integers n such that every group of order n is cyclic. We can also prove that every group of a square-free order is solvable. One can also prove some generalizations of Wilson's theorem.

(6) **Ravi S. Kulkarni**
Ramanujan Mathematical Society and Bhaskaracharya Pratisthana

Title: *Isometries of the Euclidean Plane*

Abstract: After making some comments on the role of symmetry in Mathematics, I shall explain two quite different ways of looking at the group of isometries of the Euclidean plane: 1) Geometric, 2) Complex-analytic.

(7) **Amit Kulshrestha**
IISER Mohali

Title: *Why obstruct the abstract?*

Abstract: Abstraction is almost always an ignored aspect of undergraduate teaching. Instead of introducing various related concepts as instances of the same underlying abstraction, we tend to deliver mathematics in a compartmentalized fashion. There is a hidden fear that abstraction would make the subject dry and repelling for youngsters. In this talk, through some examples I would demonstrate that abstraction is the most beautiful feature of mathematics that should be passed onto students without delay.

(8) **Keerti Vardhan Madahar**
Panjab University, Chandigarh.

Title: *Beginning of topology*.

Abstract: The subject Topology came into existence due to Euler with the advent of his solution to the Königsberg bridge problem. In this article we discuss this problem as well as some

topological invariants like Euler Characteristic, Chromatic number and Connectivity for Polyhedrons. Existence of regular polyhedrons i.e. Platonic Solids and their topological properties have been discussed. More interesting and easily conceivable but not very trivial topological spaces like Möbius Strip, Kleins Bottle and Real Projective Plane have also been discussed.

(9) **Dilip Patil**
Indian Institute of Science, Bangalore.

Title: *Factorisation*.

Abstract: Fundamental Theorem of Arithmetic and its generalization to the polynomial rings with integer coefficients.

SCHEDULE

8:15- 9:15: Registration

9.15–10.00: S. A. Katre

10.00-10.45: C. S. Aravinda

10.45- 11.00: Tea Break

11.00- 11.45: Ravi S. Kulkarni

11.45 -12.30: Keerti Vardhan

12.30-14.15: Lunch

14.15-15.00: Dinesh Khurana

15.00-15.45 : Amit Kulshrestha

15:45–16:00 : Tea

16.00-16.45: Harold Edwards

16.45-17.30: Dilip Patil

17:30–18:15: Sudhir Ghorpade

18:15–19:00: High Tea