

## Third Annual Foundational School- Part I

03-30 December 2009

Chennai Mathematical Institute

### Syllabus

**Speaker: S. Kannan, Topic: Modules over PID**

Basic theory, applications to abelian groups and canonical forms. Splitting fields, Separable and normal extensions.

**Speaker: Clare D'Cruz, Topic: Galois theory**

Algebraically closed fields. Fundamental theorem of Galois theory with applications to fundamental theorem of algebra and constructibility of regular polygons. Galois groups of cubics

and quartics Cyclotomic extensions with some number theory applications. Galois's solvability criterion, existence of Galois extensions of  $\mathbb{Q}$  with given abelian group.

**Speaker: P. Rath, Topic: Applications to arithmetic and geometry**

Finite fields with applications to quadratic reciprocity. Norms and traces, Hilbert's theorem 90,

Artin-Schreier theorem with number theory applications. Luroth's theorem with applications to algebraic curves. Galois group of  $(\mathbb{T})/K$ .

*References:*

1. M. Artin, Algebra, Prentice-Hall of India, New Delhi, 1994.
2. N. Jacobson, Basic Algebra, Vol. 1, Freeman & Co., USA, Hindustan Publishing Corporation (India), Delhi, Reprint, 1991.
3. S. Lang, Algebra, 3rd edn., Addison Wesley Pub. Co., Inc., USA, 1993.

**Speaker: Srihari Sridharan, Topic: Measure and integration**

Review of the Riemann integral. Construction of the Lebesgue measure on  $\mathbb{R}^n$ . Abstract integration theory and the main convergence theorems. The  $L_p$  spaces and applications.

*References*

1. W. Rudin: Real and Complex Analysis, Tata MacGraw Hill, New Delhi.

**Speaker: S. Kesavan, Topic: Fourier Series and Functional Analysis**

Conditional, unconditional and absolute convergence of a series in a normed linear space; notion of an orthonormal basis for a Hilbert space Trigonometric series, Fourier series, Fourier sine and cosine series Piecewise continuous/smooth functions, absolutely continuous functions, functions of bounded variation (and their significance in the theory of Fourier series) Generalised Riemann-Lebesgue lemma Dirichlet and Fourier kernels Convergence of Fourier series Discussion (without proofs) of some of the following topics: The Gibbs phenomenon, divergent Fourier series, term-by-term operations on Fourier series, various kinds of summability, Fejer theory, multivariable Fourier series

*References:*

1. George Bachman, Lawrence Narici and Edward Beckenstein, Fourier and Wavelet Analysis, Springer-Verlag, New York, 2000.
2. Richard L. Wheeden and Antoni Zygmund, Measure and Integral, Marcel Dekker Inc., New York, 1977.

3. Balmohan V. Limaye, Functional Analysis, New Age International (P) Ltd., New Delhi, 2004.

**Speaker: M. Krishna, Topic: Basic theory of ordinary differential equations:**

Existence of local solutions for first order systems, maximal time of existence, finite time blow-up, global solutions. Gronwall inequality, Continuous dependence on initial data and on the vector field on bounded intervals. Examples of linear systems, Fundamental solutions.

*Texts/References:*

Differential Equations, Dynamical Systemes and an Introduction to Chaos, 2nd Edn., by M. W. Hirsch, S. Smale, R. L. Devaney, Elsevier, 2004.

**Speaker: V. Uma, Differentiable manifolds:**

Manifolds, tangent space, immersion and submersion, regular and critical values, Sard's theorem.

Applications.

Kingshook Biswas Topic: Differential Geometry

Smooth maps, bump functions, smooth partitions of unity. Inverse and implicit function theorem. Examples. Classification of 2-manifolds. Differential geometry of curves in  $R^2$ ,  $R^3$  and surfaces in  $R^3$ .

**Speaker: P. Sankaran, Topic: Introduction to algebraic topology:**

Covering spaces and fundamental groups, simplicial complexes, simplicial homology (axiomatic approach), some applications.

*References*

1. M. P. do Carmo, Differential Geometry of Curves and Surfaces, Prentice Hall, Engelwood, NJ 1976.
2. A. Gray, Modern Differential Geometry of Curves and Surfaces with MATHEMATICA, CRC Press, 1998.
3. W. Massey, Algebraic Topology, GTM Series, Springer Verlag.
4. I. M. Singer & J. A. Thorpe: Lecture notes on elementary topology and geometry, Undergraduate Texts in Mathematics, Springer International Edition.