Syllabus for the Annual Foundation School-I (2008)

Algebra I

Modules over PIDs (8 lectures) **(** Speaker: Parvati Shastri)
The basic theory, structure theorem for f.g. abelian groups and canonical forms of matrices.

Galois theory
Part A) (8 lectures) (Speaker: S.K. Khanduja)
Separable and normal extensions, algebraically closed fields, splitting fields, Fundamental theorem of Galois theory,
Part B) (8 lectures)(Speaker: Gurmeet K. Bakshi)
Galois groups of cubic and quartics, fundamental theorem of algebra, finite fields, Galois's solvability criterion, cyclotomic and abelian extensions,

Texts/References:

1. N. Jocobson, Basic Algebra I.
2. S. Lang, Algebra, 3rd edition.
3. M. Artin, Algebra.
4. Dummit and Foote, Algebra.
5. Field Theory: I.S.Luther, I.B.S.Passi, Narosa Publishing House.

Real Analysis

Basics (12 lectures**) (** Speaker: Savita Bhatnagar**)**
Measures, Integration, Normed spaces, Baire category theorem. Open mapping theorem, Closed graph theorem, Uniform boundedness theorem.

Introduction to Fourier Analysis(6 lectures**)** (Speaker: Ajit Iqbal Singh**)**
Review of Fourier series, Basic Fourier Analysis on groups Z of integers, unit circle T and the real line R .Examples to illustrate Fourier Analysis versus Wavelet Analysis.

Basic theory of ordinary differential equations (6 lectures**)** (Speaker: Renu Bajaj)
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

1. Real Analysis by G.B.Folland, John Wiley, 1999.
2. Real And Complex Analysis by W. Rudin, McGraw Hill, 1987.
3. H.L.Royden : Real Analysis, Maxwell Macmillan International Editions.
4. Henry Helson, Harmonic Analysis, second ed Text readings in Math, HBA.
5. Yves Nievergelt Wavelets Made Easy.
6. .Michael W. Frazier An Introduction to Wavelets Through Linear Algebra (Undergraduate Texts in Mathematics) Springer, Indian Edition available .
7. Arne Jensen and Anders la Cour-Harbo, Ripples in Mathematics - The Discrete Wavelet Transform. Springer Verlag Berlin Heidelberg 2001

8. Satya Deo, Algebraic topology, A primer, HBA
9. M.W.Hirsh, S. Smale and R.L. Devaney, Differential Equations, Dynamical systems and an introduction to Chaos, Elsevier 2004.
10. Lawrence Perko, Differential Rquations and Dynamical Systems, Texts in Applied Mathematics, Springer Verlag.

Differential geometry and topology

Part A (3 Lectures) (Speaker : R.S.Kulkarni)
Revision of Calculus of n-variables, smoothness of maps defined on arbitrary subsets of R^n Inverse and implicit function theorem. Manifolds in R^n (as `submanifolds'), tangent space, induced map on the tangent spaces. Regular and critical points, Sard's theorem(statement only), regular inverse image. Classification of 1-dim. manifolds using arc-length para.

Part B): (5 lectures) (Speaker : R.S.Kulkarni)
Frenet-Serret Theory of Curves, congruence of curves, classification of compact surfaces with boundary (examples, and statement), tangent and cotangent bundles, Riemannian metrics, differential forms, first and second fundamental form of surfaces in E^3, normal curvature, Codazzi equations, congruence of surfaces, Gauss Bonnet theorem (statement).

PartC) (3 lectures) (Speaker: Satya Deo)
Richness of smooth functions, smooth partition of unity, immersions,submersions, embeddings. Abstract manifolds, different definitions of tangent space, examples Orientability.

Part D) (5 lectures) (Speaker : Satya Deo)
Transversality, Oriented intersection theory, Brauwer degree Winding number and Brauwer separation theorem, Borsuk-Ulam Theorem

Part E) (4 lectures) (Speaker : Anant Shastri)
Embedding theorems for manifolds in to Euclidean spaces. Normal bundle and tubular nbd theorem. Homotopy and stability. Vector fields and isotopies.

Part F) (4 lectures) (Speaker : Anant Shastri)
Hopf Degree theorem Lefschetz Theory of vector fields, Poincare-Hopf Theorem.

Text/References:
1) B. O'Neill, Elementary Differential Geometry, Elsevier/Academic Press (2006).
2) J. Thorpe: Elementary Topics in Diff Geometry, Springer (1979).
3) G.E.Bredon, Topology and Geometry, Springer Verlag (1993).
4) V. Guillemin, and A. Pollack, Differential Topology. Englewood Cliffe, N. J. Prentice Hall 1974.
5). A. A. Kosinski, Differential Manifolds. 138, Pure and applied Mathematics, Academic Press.
6) John Milnor, Topology from the differentiable viewpoint, Univ. Press of Virginia, Charlottesville, USA, 1965.
7) M. W. Hirsch, Differential Topology, Springer Verlag, 1976.

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