



Advanced Training in Mathematics Schools

Supported by *National Board for Higher Mathematics*

Advanced Instructional School on Atiyah-Singer Index Theorem

Venue: *Department of Mathematics, IIT Bombay*

6th July - 1st August, 2009

Conveners: *M. S. RAGHUNATHAN, R. S. KULKARNI, A. RANJAN & A. R. SHASTRI*

Brief Description of ATM Schools

Advanced Training in Mathematics (ATM) Schools are a joint effort of more than 50 active researchers across the country with support from the National Board for Higher Mathematics. The programmes are conducted in reputed mathematics departments in Summer and Winter each year. In these Schools, the emphasis will be on problems solving and on highlighting inter-relations of basic subjects in mathematics. The schools are offered mainly for Ph.D. students and lecturers. At the initial stage, ATM Schools consist of two Annual Foundation Schools (AFS I & II) in basic topics such as algebra, analysis, and topology. At a later stage, Advanced Instructional Schools in different topics in Mathematics are organised especially for students who wish to pursue research in related areas.

Advanced Instructional School on Atiyah-Singer Index Theorem

In this school, the following major topics will be discussed. Basic Differential Geometry. Manifolds, differential forms, Stokes theorem, tangent and cotangent bundles, Riemannian metrics, connections on vector bundles, jet bundles of vector bundles, linear differential operators between vector bundles, Pette theorem, Laplacian, statement of Hodge theorem. Overview of singular cohomology, CW complexes, vector bundles, characteristic classes (Chern and Euler) via axioms, existence of characteristic classes via classifying spaces, elementary facts about cobordism and Morse theory, Thom's theorem about spherical cohomology classes on manifolds. Operations with vector bundles, pullbacks, homotopy invariance, clutching construction, collapsing a closed subspace, the relative K functors, long exact sequence for a pair, Bott periodicity, half-exact functors, isomorphism of rational K theory with cohomology with rational coefficients via Chern character, Thom isomorphism in (integral) K theory for complex vector bundles. Twisted signature operator, Thom isomorphism for K tensored with rationals, comparison theorem for Thom isomorphism in rational K theory and rational cohomology, Dolbeault complex, Hodge Index Theorem, Hirzebruch-Riemann-Roch Theorem, Dirac operators. Elliptic operators, a priori inequalities, finiteness theorem for kernel and cokernel, the heat equation, the heat kernel and its asymptotics. Proof of the Atiyah-Singer Index Theorem

Eligibility for Participation

The school will admit 40 students in their first and second years of Ph.D. programme, and a few young university lecturers and college teachers. Students who have attended AFS-I/II before will be given preference to attend this school.

Financial Support

Selected participants will be paid III-AC return train fare from their place of work/home town to the venue by shortest route and provided with accommodation and local hospitality.

How to Apply

The syllabus, application form and other information about the programme is available on the website:

<http://www.bprim.org/atm>

Applications may also be made on plain paper, giving the following information: Name, Date of Birth, Age, Gender, Institute/Department, Areas of interest, Address for correspondence, email address, City, State, Pincode, Academic Record: B.Sc./M.Sc. with names of the Institutes. These should be attested by Head/Principal of the institute.

Completed application forms should reach

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by **Monday, 4th May, 2009**. List of selected candidates will be posted on the website of ATM Schools on **Monday, 11th May, 2009**.

Resource persons

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M.S. Raghunathan	TIFR, Mumbai
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