Course on
Time invariant manifolds for evolution equations

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Abstract: Consider a caloric function u, that is a solution of heat equation. An example of time-invariant manifold for u is what we also call a stationary isothermic surface, that is a surface of (spatial codimension 1) on which u remains constant (a constant that depends on time). Another example of time-invariant manifold can be considered what we call a stationary hot spot for u, that is a point at which u is always maximal and hence its gradient is constantly zero as time evolves. Time-invariant manifolds can also be defined for other linear and nonlinear evolution equations. The occurrence of time-invariant manifolds is a strong constraint on the solution: it generally implies a certain degree of symmetry. In this course, I will present the main results in this direction.

First lesson: Stationary surfaces for caloric functions: background, examples, Klamkin's problem, generalizations to other linear and nonlinear problems; statement of the main results.

Second lesson: Main tools and proofs: balance laws, short-time asymptotic behaviour of solutions, the method of moving planes.

Third lesson: Stationary hot spots in a grounded conductor.

References:
- R. Magnanini, S. Sakaguchi, Matzoh ball soup: heat conductors with a stationary isothermic surface. Ann. of Math. 156 (2002) 931.
- R. Magnanini, S. Sakaguchi, On heat conductors with a stationary hot spot. Ann. Mat. Pura Appl. 183 (2004) 1.
- R. Magnanini, S. Sakaguchi, Stationary isothermic surfaces for unbounded domains. Indiana Univ. Math. J. 56 (2007) 2723.