Benedetto Scoppola

Didattica (Teaching math in laboratory)

Period: april-may 2024, monday 14.00-17.00

SYLLABUS:
The aim of the course is to present mathematical arguments using a laboratorial approach. The arguments will be:
Penrose tiling and quasicrystal. The history of quasicrystal is a very interesting example of the interaction between mathematics and natural sciences: in the ’70 Roger Penrose introduced the concept of quasicrystal, a non periodic structure with quinary symmetry. Right after this mathematical result, many groups of physicists found, with X-rays diffraction patterns, materials exhibiting quinary symmetry. Such patterns were prohibited by the fundamental theorem of crystallography, and represented a great puzzle for the theory of the structure of matter. The natural solution has been to identify these materials as quasicrystals. Some examples of quasiperiodic tiling of the plane will be provided with a laboratorial approach, and also some experiences of waves diffraction will be realized.
Logic circuits and boolean mathematics. From an historical point of view this theme is extremely rich. One can describe to the students the circumstance in which in XX century the first computers, based on logic circuits, have been designed. One can also propose, in classical high school (liceo classico) the reading of Cicerone, who is one of the few witness of the dramatic development, in the context of the stoic philosophy of the III century b.C., of the propositional logic. An handcrafted material representing in an electromechanical way the logic circuits will be presented. We will construct a machine that is able to sum addend with an arbitrary number of bits.
Tides. This is one of the more striking example on how contradictory is the scientific progress: a chaotic mix of ancient (and nowadays lost) knowledge and superstition gave to the modern scientists the right ideas in order to understand this phenomenon. Some materials to help the students to understand the dynamical nature of the modern tidal theory will be presented, together with a mathematical quantitative description of the so called static tidal model, based on very simple mathematical instruments. Dynamical (dissipative) phenomena will be described in a more qualitative way.
Probabilistic models of vehicular traffic. It is possible to represent in a concrete way simple probabilistic models that are able to catch many interesting and unintuitive features of the vehicular traffic. Among them, the appearance of traffic in absence of bottleneck and the long range effect of the short range interaction among vehicles. The theoretical basis of the material that will be presented is one of the simplest among these models. The material gives the possibility to study the random fluctuation of a system in which the motion of each agent (vehicle) is governed by an extremely simple random model (coin tossing). The resulting theory is very simple but deep, and concrete random experiment may be realized in order to test the results obtained by probability theory