University Studies 3: Freshman Seminar
MILLENNIUM PROBLEMS

Course Details

Tuesdays, 11:00-11:50 AM, SSL129, Course Code 87608

Instructor Information

Bernard Russo. As a Professor Emeritus, I am not teaching any regular courses and I do not use my UCI office. Although I do not have formal office hours, appointments for consultation can be made by contacting me via email at **brusso@uci.edu**.

Course Description

In 2000, the Clay Mathematics Institute offered a million-dollar prize to anyone able to solve any of what it considered the seven most important mathematical problems at the time. These "Millennium Problems" were chosen not for theoretical beauty alone, but because many of them deal with concepts in fields like physics, computer science, and engineering, and exist because practitioners in those fields are already using theoretical or practical design solutions that have not been mathematically proven. Each of the seven problems would certainly be difficult to understand on your own. The seminar will provide a historical and mathematical background for each of these problems, and in the process, reveal how the solutions to some of them would bring an exponential leap for human knowledge as a whole. Several comparable problems which have been solved in the last four decades will also be discussed. A passing knowledge of mathematics is important but a major in the subject is not, and this seminar should satisfy anyone wishing to know more about modern theoretical and applied mathematics.

Assignments and Grading

No reading assignments or problem sets. Only a term paper. However, much (optional) reading material will be suggested and posted online during the quarter. Grading will be on an absolute scale determined as follows:
90=A,75=B,60=C, etc (Attendance is important, participation even better)

- **50%** Attendance
  10% is free; another 5% for each meeting attended

- **50%** Term Essay (on a topic of your choice) 5 to 10 pages with bibliographic references. Due on Thursday of final exam week (Extensions are possible to as late as Tuesday of the following week). Suggestions for your topic will be made throughout the quarter.

SOME TOPICS

The Music of the Primes

- The Riemann Hypothesis

- The Prime Number Theorem

- Bounded Gaps Between Primes

Smooth Behavior

- The Poincare Conjecture

When Computers Fail

- The P versus NP Problem

- The Four Color Problem

Making Waves

- The Navier-Stokes Equations

Knowing When the Equations Can't be Solved

- The Birch and Swinnerton-Dyer Conjecture

- Fermat's Last Theorem

Geometry without Pictures

- The Hodge Conjecture

The Fields we are Made Of

- Yang-Mills Theory and the Mass Gap Hypothesis

- The Classification of Finite Simple Groups

SOME REFERENCES

- "The Millennium Problems. Seven of the greatest unsolved mathematical puzzles of our time" by Keith Devlin, 2002.

- "Love and Math. The heart of all things," by Edward Frenkel, 2013.

- "Symmetry and the Monster. One of the greatest quests of Mathematics," by Mark Ronan, 2006

- "Symmetry. A journey into the patterns of nature," by Marcus du Sautoy, 2008