# Physics and the Physician

## Draft Proposal for a Freshman Seminar course

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**Course Description:**
Applications of physics to directly address problems involving human health are rapidly advancing. Developments in physics have already led to, and hold great promise, for improvements in the diagnosis and understanding of disease, as well as in the application of high technology to patient care. Examples include the use of lasers for surgery, high energy photon and electron beams for cancer therapy, the invention of the computed tomographic (CT) scanner, the development of the magnetic resonance imager (MRI), non-invasive ultrasound imaging and the list goes on.

This course will review some of the major advances in current and emerging medical technologies that have had their origin in the Physics community and rely on the applications of Physics principles. Many of these Nobel Prize winning advances, such as the invention of the laser and discovery of x-rays have revolutionized the field of medicine.

The course will assume an interest in basic physics, applied physics, engineering or medicine although no specific prerequisites are required. Motivated students from any discipline should be able to keep up with the technological aspects of the course as most of the necessary technical concepts will be highlighted during the quarter. In addition to lectures/ demonstrations and expert guest speakers, students will visit on-campus facilities to observe the use of many of these technologies in clinical and research settings.

**Course Format:**
The course will meet twice a week (48 minutes each).

**Grade Weights:**
The course is worth 2 credits where evaluation is based on a numerical grade scale.

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|---|---|
| Attendance, class participation and discussion | 100 points |
| Written assignment | 100 points |

Attendance is 40 points and participation in class meetings 60 points. Two unexcused absences will be allowed during the quarter. Each absence after that will cost 5 points. Each week a brief reading will be assigned which will be the basis for discussion the following week. A few students will be identified to make a short presentation (~5 min) each week. These students will be required to submit via Carmen a synopsis of their presentation. All other students are expected to come to the seminar prepared to participate in the discussion.

Written assignment will consist of selecting one topic from the reading list or on topics approved by the instructor. The reading list will typically consist of articles at the level of those appearing in Scientific American, Science Daily and other popular scientific magazines, websites or books. From these topics, one 750 - 1000 word essay will be required. Requirements for the essay and due dates will be provided during the first week of class.

The final grade will be determined by the percentage of total points accumulated. The grade scale to determine the final course grade is:

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|---|---|---|---|
| 93 -100 | A | 77 – 79 | C+ |
| 90 – 92 | A- | 73 – 76 | C |
| 87 – 89 | B+ | 70 – 72 | C- |
| 83 – 86 | B | 67 – 69 | D+ |
| 80 – 82 | B- | 60 – 66 | D |
| | | 59 or below | E |

# Tentative Schedule

Week 1.
Introduction: Basics of Light, Sound and Magnetism

Week 2.
Lasers - Principles of the laser, types of lasers and laser-tissue interactions

Week 3.
Lasers in Ophthalmology

Week 4:
Micromanipulation. Laser tweezers for cells. Visit to a clinical or research laser facility.

Week 5
Magnetic Resonance – fundamentals, applications to medicine.

Week 6.
Magnetic Resonance imaging. Visit to OSU 8 Tesla Magnetic Imaging center

Week 7
Radiation Physics - use of penetrating beams of high energy waves or streams of particles to “see” inside the body, find and treat disease

Week 8.
X-ray tomography to image processes in the human body for medical applications

Week 9.
Principles of Ultrasound for non-invasive diagnosis: broken bones, kidney stones and monitoring the fetus. Visit to ultrasound laboratory

Week 10.
Physics of emerging medical technologies

**Biography:** R. Sooryakumar is a Professor in the Department of Physics. He received his Ph.D in Physics from the University of Illinois at Champaign-Urbana. Prior to joining OSU in 1984, he spent three years at the Max Planck Institute in Stuttgart Germany as an Alexander von Humboldt Fellow. Dr. Sooryakumar's expertise is in the application of laser techniques in the study of materials, and he seeks to gain an understanding of their optical, electronic and magnetic properties as well as mechanical behavior. His research has included studies on ultra-small magnetic arrays and membranes, glassy semiconductors, exotic superconductors and biological tissues.