# Physics 102 – Visions of the Multiverse
# Spring term 2011, University of Rochester
*Information, Syllabus, and Schedule*

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This is an introductory course designed especially for students in the humanities and other non-scientific fields who are interested in learning about science, physics and concepts of a multiple universe reality. Topics include the nature of science, Newton's laws, relativity, light, quantum mechanics, the nature of particles and forces, and cosmology. In the course of surveying the modern scientific view of the universe, a number of serious concepts of a multi-universe reality will be examined, including the many-worlds view of quantum mechanics, inflationary and string-based cosmologies. There are no prerequisites, no background knowledge is required and the material will be presented with very little mathematics. Substantial use will be made of demonstrations. This course is intended to be equivalent to our Physics 100 course in terms of satisfying cluster requirements.

**Course instructor:**

Prof. Steven Manly e-mail: **steven.manly@rochester.edu**
Phone: 275-8473
Office: B+L 203E

Office hours: **Monday 11 am-noon and Thursday 1:30-2:30 pm *or by appointment.*** With my travel and your variable needs/schedules, I find that fixed office hours are not terribly practical. If I am out of town or if the listed time slots do not work for you, speak to me or send e-mail and we will find a mutually suitable time to meet.

**Course web site:**

Extensive use will be made of the web for distributing course materials, making announcements, etc. The class URL is
http://www.pas.rochester.edu/~manly/class/P102_2011S/ .
If you have difficulty reaching this site (and you've verified it is not your problem), please contact me. I will also use of the Blackboard course management system. In particular I will use that system to email the class, report grades, and distribute material that should not be openly accessible on the web. It is essential that you let me know if you are not receiving emails sent to the class. I apologize for using two web venues; but there are technical reasons why this works best for me/us.

**Lectures:**

Hoyt Auditorium, Monday and Wednesday from 2-3:15 pm

**Recitations:**

Morey 505, Monday 5-7 pm
Morey 505, Wednesday 5:30-7:30 pm
Hylan 105, Friday 2-4 pm

**Textbook and readings:**

- Art Hobson, **Physics Concepts and Connections**, 5th edition (2010), Pearson Prentice Hall.
- Hobson's text is a decent text for a conceptual physics survey course. That said, Hobson's text is not really designed for this course. So, I will assign scattered readings from the text and many readings outside of the text.

**Philosophy and goals:**

Physics 102 is meant to be fun and interesting. There is nothing as wacky as reality and it will be my pleasure to take you on a guided tour of some of the delightfully twisted parts of our universe. This is a conceptual course. The use of mathematics will be limited.

I have three pedagogical goals in this course. When it is over, I hope you have an appreciation of the nature of science, how it works and what are its strengths and shortcomings. Second, I would like to paint for you the modern scientific view of the universe. Finally, I want to explore with you numerous concepts of a multi-universe cosmic reality – mostly arising in modern physics, though we will discuss other ideas. It is my hope that this experience will help you appreciate the depth of the strangeness in our universe and the degree to which science (and physics in particular) shapes the life you live.

**Lectures, readings and recitations:**

Unlike many science courses, there is no textbook that fully covers the material in this course. As such, it is important that you attend lectures and recitation and keep up with the readings.

Each week you will meet for up to two hours in what we'll call a "recitation" section with a teaching assistant with whom I will work closely. During this time you will work through a series of questions and problems that I will pose to you as a group. These questions and problems will be designed to promote discussion and critical analysis of the readings, help you learn to do simple quantitative problems, and break some new ground meant to support the goals of the course.

In an attempt to de-emphasize the quantitative exam based aspect of this course, I am making your attendance of, preparation for, and participation in the recitations a very significant part of your evaluation in this course. As such I request that you use name cards in each recitation. Your TA will be asked to provide me with a number for each student attending that section (you can change sections in a given week if your schedule requires it). That number ranges from 1 to 3. A "3" indicates the student appears to have done the reading and participates in the discussions and work of the recitation. A "1" indicates the student showed up unprepared and did not participate in any reasonable sense. A "2" indicates obvious lack of preparation but willingness to jump in and participate or vice-versa. Students not attending recitation in a given week receive 0 points for that week.

We will have roughly 10 recitations during the course of the semester. That means each student can get as many as 30 recitation points during the term. I understand that illnesses and worthy distractions happen and that you will need to set priorities at times that may prevent you attending recitation once in a while. In recognition of this, the recitation scores will be calculated assuming a perfect score of 24. You can miss 6 points (two full recitations) and still receive a 100 percent score for this part of the course. Things will scale proportionally if, for some reason, we end up having 9 or 11 recitations instead of 10.

**Makeups/missing exams and problem sets:**

I will evaluate your grade using three separate algorithms shown below. If you are present for each exam, this scheme will end up dropping your worst grade. If you miss an exam, that missed grade will count as your drop. I will not give makeup exams in this course. If you miss both exams 1 and 2, contact me … preferably before you miss the second exam if you know about it in advance.

**Grades:**.

- Your grade will be calculated via one of the three schemes shown in the table below, taking the one that yields the highest numerical average. The numbers represent the relative contribution of the item in that column to your final numerical grade.

| Scheme | Exam 1 | Exam 2 | Final exam | Recitation |
|---|---|---|---|---|
| **1** | --- | 25% | 35% | 40% |
| **2** | 25% | --- | 35% | 40% |
| **3** | 17% | 17% | 26% | 40% |

- Your initial relative position on the grading curve depends solely on the numerical grade as calculated above. I will then assign letter grades to the numerical scale.
- If I perceive the exams to be very different in difficulty (wildly varying mean grades). I will normalize the means to the same value, say 75. In other words, if the mean of exam 1 is 62 and the mean of exam 2 is 85, in the final calculation I will scale everyone's exam 1 grade by 75/62 and everyone's exam 2 grade by 75/85. Such a scheme must be in place to insure fairness when there is the potential for grades to be dropped.

**Course Schedule:**

This course syllabus is tentative. I may adjust the speed or topics as the course evolves. Reading assignments will be provided later and as we proceed through the term. The exam dates are fixed.

**Wednesday, January 12, 2011** – course intro, intro to the multiverse, human bias
**Monday, January 17, 2011** – No class … human bias, nature of science
**Wednesday, January 19, 2011** – space and time
**Monday, January 24, 2011** – space and time
**Wednesday, January 26, 2011** – forces and fields
**Monday, January 31, 2011**- forces and fields
**Wednesday, February 2, 2011** – forces and fields
**Monday, February 7, 2011**- electromagnetic radiation
**Wednesday, February 9, 2011** – waves and particles
**Monday, February 14, 2011**- rise of quantum mechanics
**Wednesday, February 16, 2011**- quantum weirdness and quantum uncertainty
**Monday, February 21, 2011**- many worlds interpretation of quantum mechanics
**Wednesday, February 23, 2011 – exam 1, Hoyt Aud., during normal class time**
**Monday, February 28, 2011** – inner space, nuclear physics - radioactivity
**Wednesday, March 2, 2011** – nuclear physics – bombs and power
**Monday, March 14, 2011** - nuclear physics – stellar life cycle
**Wednesday, March 16, 2011** – black holes and fecund universe
**Monday, March 21, 2011** – inner space – particle physics
**Wednesday, March 23, 2011** – outer space - cosmology
**Monday, March 28, 2011**– big bang cosmology
**Wednesday, March 30, 2011**- inflation, beyond-the-horizon multiverse, dark matter
**Monday, April 4, 2011**- dark energy, bubble multiverse
**Wednesday, April 6, 2011**– warped space and strings
**Monday, April 11, 2011** – strings and the cosmic landscape
**Wednesday, April 13, 2011** – ekpyrotic universe
**Monday, April 18, 2011**- anthropic principle, sims, religion
**Wednesday, April 20, 2011 – exam 2, Hoyt Auditorium, during normal class time**
**Monday, April 25, 2011**– mathematical multiverse, multiverse taxonomy reprise
**Wednesday, April 27, 2011** - coming soon in a universe near you
**Tuesday, May 3, 2011 – Final exam, 4 pm, location TBA**