HONR 289V:
Exploring Mars
Spring 2017

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HONR289V Course Description

We live at an exciting time for planetary exploration. Our robotic spacecraft have journeyed to all of the planets and to a number of asteroids and comets as well. Our probes have orbited other planets, dipped into their atmospheres, and driven across alien landscapes. We have brought samples back from the Moon and from nearby asteroids. Humans have safely traveled in space for half a century and have walked and driven on the surface of the Moon. As our nearest potentially habitable planetary neighbor, Mars has been a prominent target for the full history of space exploration, and its importance only increases when we contemplate the potential for future human visits. This course will address big questions in Mars exploration. What have we learned from the past 50 years of spacecraft visits? What is the proper balance between robotic and human exploration today, and for the next decade? And finally, what long term Mars exploration goals should our society be working toward?

This subject lies at the intersection of many areas of human endeavor. On the one hand, science discoveries refocus our attention in new directions, inform engineering design, and allow for ever more capable space vehicles. Policy decisions, fiscal realities, and international collaborations and rivalries interact in complicated ways to affect what we actually choose to do as a society. In HONR289V, we will explore these important issues by first tracing the history of Mars exploration over time, understanding its costs, benefits, and the forces that drive it forward. We will then look at mission plans

for the near future, the next twenty years or so, to get a sense of where we are headed. Are we headed in the right direction? If not, what can be done to change the direction? Finally, we will consider what Mars exploration might look like over your lifetimes. Should the ultimate goal of our exploration program be human visitations, a permanently manned base, or full colonization?

I have several objectives in teaching HONR289V. First, I want you all to gain a greater appreciation of the exciting history of the unmanned Mars program. Along the way, we will learn a great deal about Mars as a planet, and the basics of spaceflight. We will relive the glorious successes of the past and see some spectacular failures. Space flight is inherently dangerous and not for the faint of heart! Second, building on a solid understanding of the fundamentals, I would like you to form informed opinions on a number of Mars exploration issues. What should be our near and long term priorities? There are many differing opinions on these question and no single path forward. You will get the chance to discuss your opinions openly with others who may disagree with you. Through discussion and debate, I would like you to come to consensus on some of the simpler questions, and to paint a clear picture with both pros and cons for the more complicated issues. Finally, we will organize into groups that will focus more intensely on specific questions. Working on a team is an important part of most modern careers, and it is not so often that you get the chance to do so in the classroom. Make the most of the opportunity! Once we have as a firm a grasp of the issues involved as possible, we will together chart our own vision for our Mars exploration policy. This is our overall goal as a class.

Assignments and Grading

Student evaluation will be based on participation in animated discussions, debates, a group project, short quizzes, reading responses, and midterm and final exams.

- **Quizzes:** There will be several quizzes to test your knowledge of the reading and topics covered in class. We will have a practice quiz question in class before the quizzes start, and I will also warn you in advance of the first quiz. Subsequent quizzes, however, will be unannounced.
- **Reading Responses:** Each week, you will submit a 1-page summary of i) your reaction to the week's reading ii) your investigation of a related topic of interest to you.
- **Group Project:** A few weeks into the semester, you will have a choice of joining one of several task forces that we will set up to investigate major Mars initiatives (e.g. Sample Return, Human Visit, Longterm Mars base, Full Colonization). Your task force will be responsible for gathering and synthesizing information for preparing a final presentation to the class. Evaluation will be based on your individual 10-page writeups (50%), your part of the group presentation (40%) and the group organization of topics (10%).
- **Midterms:** The midterms will consist of a mix of questions based on topics covered in class and the reading. The tests will include some qualitative short answer questions, some quantitative questions, and some short written responses.
- **Participation:** A large part of each class period will be devoted to a discussion of the assigned reading and/or relevant current events. These discussions are more fun, more interesting, and more relevant if you take an active role in contributing to them. Informed participation in the debates and posting interesting posts to the class blog will also count toward your participation grade. Maximum participation scores will be awarded to students who keep up with the reading, regularly bring interesting topics and questions to class, actively help to shape discussions, and do well in debates.

I grade on a point scale with different assignments weighted as shown in this table.

ASSIGNMENT	Quizzes	Reading Responses	Group Project	Midterm Exam I	Midterm Exam II	Participation	Total
POINTS	About 100	195	150	100	100	About 100	750

This class is not designed to be an "easy A" - if you are seeking such a class, now is the time to move on. My expectation is that roughly half of you will earn As, half will earn Bs, and no one who puts in a sincere effort and keeps up with the workload will get a lower grade. The number of points required to get a given grade will depend on the class average, however, getting 90%, 80%, 68%, of the total possible points guarantees you at least an A, B, or C, respectively. You can monitor my current estimate of your grade as the semester progresses from the *What's my Grade Right Now?* link on the class webpage.

Class Policies

This course will conform to all applicable Campus Policies. In addition, I have a specific policy on laptops and cell phones. In principle, laptops can allow you to take notes faster and access the class website but, in practice, they are most often used for other distracting purposes. I prefer that you don't use laptop in class, but please come talk to me if you have a good reason to. And as a courtesy to others, please turn off your cellphones while in class.

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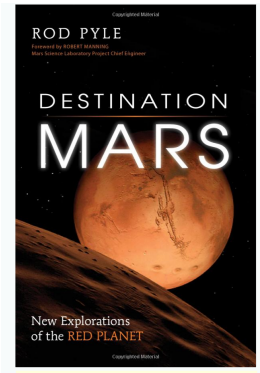
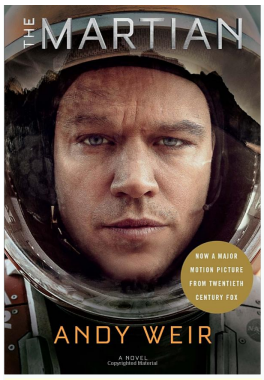
HONR289V Textbooks



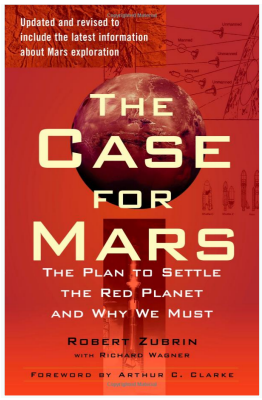
Required:

Destination Mars Rod Pyle (2012), About $15.



Required:

The Martian, Andy Weir (2014). About $15.



Required:

The Case for Mars (Revised Edition), Robert Zubrin (2011). About $15.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HONR LECTURE SCHEDULE

Lecture Date	Lecture Topic	Reading
Mon. Jan. 30	Introduction to Mars	Also, Always Read Weblinks Posted on the Class Website
Mon. Feb. 6	Early History of Mars Exploration	Destination Mars; Chapters 1-9
Mon. Feb. 13	Early History of Mars Exploration	Destination Mars; Chapters 10-15
Mon. Feb. 20	Recent History of Mars Exploration	Destination Mars; Chapters 16-21
Mon. Feb. 27	Recent History of Mars Exploration	Destination Mars; Chapters 22-26
Mon. Mar. 6	Midterm	Destination Mars; Chapters 27-32
Mon. Mar. 13	Current Mars Exploration	The Martian; Chapters 1-5
Mon. Mar. 20	Spring Break!	
Mon. Mar. 27	Future Planned Missions	The Martian; Chapters 6-16
Mon. Apr. 3	Future Planned Missions	The Martian; Chapters 17-26
Mon. Apr. 10	Midterm	The Case for Mars; Prefaces, Foreword, Chapters 1-3
Mon. Apr. 17	Future Manned Exploration	The Case for Mars; Chapters 4-5
Mon. Apr. 24	Future Manned Exploration	The Case for Mars; Chapters 6-7
Mon. May 1	Future Manned Exploration	The Case for Mars; Chapters 8-9
Mon. May 8	Final Papers and Presentations	The Case for Mars; Chapter 10, Epilog, Addendum, Appendicies
Wed. May 17	Final Papers and Presentations	During our Final Exam Period: 1:30pm-3:30pm


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HONR 289V Assignments

Please turn in all assignments reading responses and other assignments as PDFs from this website. I will return the hardcopy to you with comments and will keep the electronic copies as a record of your responses.

Reading Responses

Each week, except as noted in the lecture schedule, there will be a reading assignment. Before the relevant class, please read the selections from our books as well as any supplementary websites listed on the HONR289V homepage. Follow up on one of the topics raised by the assigned reading that interests you and research it using at least one additional online source. Write one single-spaced typed page on your reaction to the assigned reading. A good essay will include a concise description of the topic covered, as well as your reaction to it. What did you learn and what do you still find confusing? Your reaction should be honest and it may be emotional (was the reading interesting? exiting? tedious?), but must be well argued and must include your thoughts instead of just being a straight summary of the reading. In one paragraph, indicate a relevant webpage not listed on the reading list, and your response to it.

Task Forces

Early in the semester, 4-6 of you will join each of the following task forces and together will work to learn more about one of the following topics:

- Sample Return
- Human Visit
- Long-Term Base
- Colonization

Later in the semester, your task force will divide its topic into logical and roughly equally-sized subtopics, one of which you will take charge of. Try to choose subtopics in a logical way such that your task force covers the entire topic.

Final Paper

You each will ultimately write a 10 page double-spaced paper on your subtopic which is due the Monday of finals week. Try to write at a level that can be understood by non-experts (that means define any terms that you did not know before taking this class). Things to consider might include timelines, costs, technical feasibility, and relevant emerging technologies. Try to make some of the hard calls - include your own opinion on whether the project should be undertaken and, if so, at what cost and on what timescale. Undertake your research by finding multiple sources that discuss your topic (magazine articles, newspaper articles, web postings, etc.). Try to fully understand your topic and summarize it in your paper, citing your sources as appropriate. If you have questions about the appropriateness of a particular topic, please feel free to ask me.

Task Force Presentation

Your task force presentations should be a thorough summary of your papers. The presentation should take about seven minutes per group member, with three minutes for questions. Questions can come after each individual talk or at the end of the full presentation. Your goal as a group is to cover your topic as clearly and completely as possible, both in this presentation and in individual written papers. Be honest about the advantages and disadvantages of the different future approaches to Mars. Each Task Force presentation should make specific recommendations for the future. Please try to divide up the work evenly so that each contributor presents his or her fair share of the material. Turn in original and PDF copies of your presentation before the relevant class so that they can all be presented from my computer. Your goal as an audience is to ask key questions to help you understand the material.

Class Debates

We will have several formal debates during the class and I will inform you of the debate topic one to two weeks in advance. As you will have prior knowledge of the topic, I will expect you to prepare in advance. The debate structure will follow the outline below.

- Divide into four or five groups of 4-5 students.
- Group discussion of major points for and against each side (10 min.)
- Random drawing to determine group roles: Side 1, Side 2, Judges
- Further group discussion of specific arguments (5 min.)
- Random drawing to determine roles: Lead Speaker, Rubutter, Note Takers
- Random drawing to which side goes first
- Lead Speaker for Side 1 (5 min.)
- Lead Speaker for Side 2 (5 min.)
- Rebuttal from Side 1 (5 min.)
- Rebuttal from Side 2 (5 min.)
- (Occasionally) Second Rebuttal from Side 1 (5 min.)
- (Occasionally) Second Rebuttal from Side 2 (5 min.)
- Discussion amongst Judges to decide which side won (5 min.)
- Discussion amongst Judges to decide which side won (5 min.)
- One sentence statements and votes from each Judge (5 min.)
- Prof. breaks any ties

I will allocate times for you to discuss collectively the major points for and against the proposition. The role of your group and your role within the group will be determined by random drawing. For example, in an early debate, one group will argue for expanding Mars exploration at the expense of other Solar System opportunities while the other group will argue for the reverse, and the remaining groups will judge. Unlike in competitive debates, we are not looking for rapid presentation of many points, but rather a clear presentation of the key points. Each side begins with an opening argument and then responds to the other side with one or more rubuttals. After the debate, each of the judging groups confers separately, and then each individual judge decides who he or she thinks won the debate. A judge should select as winner the group that he or she feels presented their side best, and not necessarily the group whose arguments he or she agrees with. I will poll the judges individually for their statements and votes. I will arrange things so that all students take on at least one and no more than two speaking roles in the debates. These count toward your participation score.


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