The Robotics Incursion - Syllabus

We will examine the topics listed below (although, as always, the management reserves the right to make last-minute changes). Several quizzes, two or three tests, in-class participation, evaluation of the previously mentioned written paper and team project, and a final exam will allow an assessment of what has been learned during the course. Several films will be viewed as part of the course, and readings taken from the literature will be required. As several of the topics to be covered are co-dependent, the list below should not be considered to be chronological.

1. **What is a robot**?
   How is a robot different from a machine?
   What does it mean to think?
   Is thinking the same as solving problems?
   Decisions, decisions ...
2. **Imagine a human-like machine**:
   Basic science sets the fundamental boundaries
   Applied science sets the practical boundaries
   Apply the scientific method
   Build an autonomous machine (in theory, and in practice)
3. **Should we build robots at all**?
   Social implications
   Moral implications
4. **How to make a robot**
   move, listen, see, decide, react, etc.
5. **Robots - the history**
   In science
   In science fiction
6. **Robots - the present**
   In industry
   In the home
   In the laboratory In
   the military
   In the arts
7. **Robots - the future**:
   What is being worked on?
   What is possible, and should moral values limit what we try to create?

The Robotics Incursion - Course Outline

This course looks at the scientific capability, potential and limitations of robotics and the societal implications of their advance. The history of how machines, automation and robotics have changed our lives and what is projected for future machines will be explored. In addition to typical classroom activities, students will have the opportunity to work as teams to build, program and experiment with various robotic implementations.
Some of the issues that will be used to stimulate student involvement and thereby lead to the attainment of desired learning outcomes are contained in the following paragraphs:
We continue to passively witness the incursion of machines into our lives, usually with unthinking acceptance. Financial transactions become rote, from the cashier at the supermarket who only needs to push a few buttons to calculate totals and make change on items that no longer have prices printed on them, to the ATM that doles out cash we often don't even bother to count. Skilled workers are replaced by even more skilled robots that work tirelessly with no demands for compensation. New and smarter machines are being developed at an exponential rate, and it seems that every advance in the ability of machines to think gives license to negate the need for humans to think. The specter of HAL still hangs over us and the question of if (or when) computers will be intelligent enough to propagate and learn without human intervention has not yet been answered, at least not to the satisfaction of all. More pressing perhaps is that only a relatively few humans with very sophisticated knowledge are needed to develop machines that render the skills that make up the traditional work force obsolete. Perhaps the danger is not from overly intelligent machines, but rather from a movement to a technocracy wherein power comes from the ability of an elite priesthood to control the machines we find we cannot do without.

To study how the robotic incursion affects our lives involves more than just a look at a current technology. On the one hand, it offers the student an opportunity to see how the diverse scientific fields of physical optics, electromagnetics and mechanics merge with the computational fields of mathematics and computer science to provide a framework for the development of intelligent machines. Of equal interest is the way in which the broader field of robotics impinges on social and philosophical issues. Questions such as the morality of designing "thinking" machines, especially ones that replicate human characteristics and may replace their human counterparts provide topics for student exploration, as does the social impact of robots on the work force. A unique advantage of the subject matter of this course is its breadth of scope. Technical, social, political, philosophical, religious and environmental issues are all contained in the fabric of this emerging technology. Thus it is an excellent vehicle for students with diverse interests to explore, and will develop their ability to examine modem-day issues by investigating and reporting on their analysis of topics from a broad spectrum that are of interest to them.

The Student assessment plan:

Teams (usually of three members) will be assigned to work on projects. Each team member will have specific responsibilities upon which other members of the team will rely. Effectiveness in organization, planning and completion of the team project, both individually and as a whole, will be a significant contribution to the course grade.

Homework will be assigned, aside from the readings mentioned above, as is appropriate to focus attention on particular matters of interest that may arise during the conduct of the course. Homework should be submitted in a timely manner and be neat, legible and literate. You should regard homework as "mini research projects" and so apply proper research techniques to these assignments. Homework will be corrected and so will be part of your overall course grade.

There will be two or three (depending on class progress) exams during the semester, and a comprehensive final exam. A report in the form of a term paper and team report on your team's project are to be submitted for grading at the end of the semester. You should keep a journal of your work, including a running account of activity and results related to your team project. (In the science business we call this a lab notebook.) I will ask for an update on your progress from time to time, and this will be accomplished by reviewing your lab notebook.

(Here is my attempt at a “rubric”)

Outcome	Beginning	Developing	Accomplished	Advanced	Exemplary
Contributions to class discussions	Seldom contributes; often misses classes	Contributes on occasion, but does not initiate discussions	Sometimes initiates discussions; generally is involved in discussions	Often initiates discussions; is knowledgable about wide range of topics	Often initiates discussions; tends to lead the class in analysis of the topic; shows firm grasp of most matters related to the course
Contributions to team project	Mostly observes other team members; often disinterested in project; not sure of assigned role; lab notebook unorganized	Generally is interested in project, but relies on others for help; does fair job on assigned part of project assignment; acceptable notebook	Has overall understanding of group project; understands role on project; Well documented notebook; shows some leadership skills	Knows role in project; understands overall goals of the team; often helps others with ideas and suggestions; excellent notebook skills	Clear leader of the team; guides others in all aspects of the project; offers innovative solutions to problems; professional quality notebook

Quality of submitted homework	Homework is marginal in quality; some parts not submitted at all; some assignments not submitted at all	Usually completes homework assignments; style and grammar often lacking; sometimes point of the assignment is missed	Always submits homework on time; problems are usually done correctly; paper generally neat and literate	Always submits homework on time; solutions usually well thought out; paper always neat and literate	Always submits homework on time; shows insight into the problem and its solution; often suggests alternate solutions; paper always neat and literate
In-class Exam results	Typically in bottom 25% of the class; has difficult time with most assigned problems	Typically in bottom 50% of the class; gets parts of most problems but often misses key issues	Typically in top 50% of the class; solves some problems completely and gets parts of others correct; usually gets key issues from problems	Typically in top 20% of the class; usually solves most problems completely; clearly understands objectives of the problems	Typically in top 5 to 10% of the class; easily solves most or all problems, often adding additional insight
Term Paper	Marginally written in poor style; many typographical erors; shows minimal knowledge of submitted topic	Acceptable style and content; fair grasp of topic; some indication of insight into subject material; more than just a re-write of the work of others	Good style and format; challanging topic; well thought-out conclusions; clear indication of good research techniques	Excellent style and format; good use of vocabulary as related to topic; clear insight into work researched and its implications	Excellent style and format; clearly gained understanding of assigned topic; offers new ideas about context of work researched
Final exam results	In bottom 25% of the class; has difficult time with most assigned problems	In bottom 50% of the class; gets parts of most problems but often missed key issues	In top 50% of the class; solved some problems completely and got parts of others correct; usually got key issues from problems	In top 20% of the class; solved most problems completely; clearly understood objectives of the problems	In top 5 to 10% of the class; easily solved most or all problems, often adding additional insight

Tentative sources and materials:

The primary text for the course is Brooks, Rodney A., "Flesh and Machines

Readings will also include, but not limited to:

http://www.asimovonline.com/ The web site dedicated to the works of Isaac Asimov.

IEEE Robotics & Automation Magazine – Technical articles (but, for us, mainly abstracts showing current work in robotics research).

US First (A program set up by Dean Kamen - inventor of the Segway Human Transporter). http://www.usfirst.org/

Robotics and Art: An overview and interaction with the MCLA Robotic Arts Project

Lego MindStorms: Teams of students will use kits available within the department to design, construct and program autonomous robits.

We will view two films: I Robot and 2001: A Space Odyssey

A brief (and preliminary) web site for the course has been set up at http://w.g.seeley.tripod.com/2005_physics/index.htm