Rutgers University, Department of Electrical and Computer Engineering
ABET COURSE SYLLABUS
COURSE: 14:332:478

Course Catalog Description: 14:332:478 Capstone Design – *Virtual Medical Systems*
Capstone design experience in medical applications of virtual reality. The course focuses on team-oriented design projects involving either or both hardware prototyping or software design of applications of virtual reality in Medicine. Emphasis will be on computer games for rehabilitation. Students participate in a design process that incorporates realistic engineering constraints such as real-time rendering, ergonomics, design for usability, as well issues dealing with patient safety and confidentiality of data.

Pre-Requisite Courses: 14:332:221, 14:332:252, 14:332:376 and 14:332:378

Co-Requisite Courses: 14:332:331

Pre-Requisite by Topic: Programming Methodology I, Principles of EE I, Computer Architecture, Virtual Reality, Virtual Reality Laboratory. Virtual Reality can be substituted by Introduction to Computer Graphics or by Robotics and Computer Vision.

Textbook & Materials: *Virtual Reality Technology*, 2nd Edition, Burdea and Coiffet, Wiley, 2003 or subsequent editions.

References: Technical literature from industry, journals and Internet.

Overall Educational Objective: Design projects involving virtual reality simulations, game design, or mechatronics systems, as well as understanding concepts of human-computer interaction, motor/cognitive rehabilitation and brain plasticity.

Course Learning Outcomes: A student who successfully fulfills the course requirements will have demonstrated:
1. An ability to design a system or process to meet given specifications with realistic engineering constraints.
2. An ability to function as a member of an engineering design team.
3. An ability to utilize technical resources both from prior relevant coursework, as well as from sources students must seek out on their own (e.g., various technical literature, data sheets, webinars, tutorials on programming techniques and brain anatomy, etc.)
4. An ability to write technical documents and give technical oral presentations related to design project results.

How Course Outcomes are Assessed:
Project proposal (20%)
Design review reports and presentations (30%)
Final design project report (25%)
Final design project oral presentation (25%)

N = None S = Supportive H = Highly related

Outcome	Level	Proficiency assessed by

(a) an ability to apply knowledge of Mathematics, science, and engineering	H	Design experience and final report
(b) an ability to design and conduct experiments and interpret data	H	Design experience and final report
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	H	Design experience and final report
(d) an ability to function as part of a multi-disciplinary team	H	Team effort in the design process
(e) an ability to identify, formulate, and solve ECE problems	H	Design experience and final report
(f) an understanding of professional and ethical responsibility	S	Research related to design process
(g) an ability to communicate in written and oral form	H	Writing technical reports and giving oral presentations
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	S	Research in the design process related to motivation and dealing with realistic constraints
(i) a recognition of the need for, and an ability to engage in life-long learning	S	Research related to design process
(j) a knowledge of contemporary issues	S	Relevance of the design project
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	Design experience and final report
Basic disciplines in Electrical Engineering	H	Design experience and final report
Depth in Electrical Engineering	H	Design experience and final report
Basic disciplines in Computer Engineering	H	Design experience and final report
Depth in Computer Engineering	H	Design experience and final report
Laboratory equipment and software tools	H	Design experience
Variety of instruction formats	S	Lab and Office Hour discussions

Course description:

This course focuses on small team-oriented design projects to demonstrate the impact of hardware human-computer interface, game choice and performance, real-time data sampling and processing on medical outcomes (with emphasis on game therapy). The course will cover basic theory and techniques of hand motor rehabilitation, advance rehabilitation using virtual reality, experimental protocol design and approval, technology shortcomings and solutions, network communication and reliability, monitoring and data archiving, patient/system safety. We will use real-time graphics techniques, sensing glove interfacing with game consoles, hardware and software design and implementation. The course is most appropriate for those interested in pursuing careers in game programming for medical informatics, networks, human-machine interfaces, and who are motivated to have a positive impact on the society. Measurements, simulations, and/or characterization of system performance is done so as to demonstrate that the design objectives and specifications have been met. Design projects are accomplished through team effort with teams comprised of up to 3 students. The final design project reports must address issues, as appropriate, that are related to manufacturability, engineering economics, environmental, social, as well as health and safety. Each design team must prepare and deliver oral presentations describing their design process and results. The objective of this course is to provide a comprehensive capstone design experience for students in a small team-oriented format that is consistent with ABET requirements.

The course structure consists of weekly meetings throughout the semester with students that have been organized into design teams. Faculty participation in the design process involves mentoring and oversight in the following areas:

(1) guide students as they proceed with their project designs

(2) monitor the progress of project designs

(3) expose the students to various economic, ethical, and social effects related to their design projects

(4) present methods of writing technical reports and interact with students to enhance their writing skills

(5) present methods of public speaking and interact with students to enhance their oral presentation skills

At the conclusion of each design project the design team is required to submit a written technical report describing the details of the final design process and results, as well as highlight relevant conclusions. At the end of the semester each design team is required to prepare and deliver publicly (especially to the class as a whole) an oral presentation describing the final design project.

Computer Usage: Simulations using virtual reality software packages. Technical reports and presentations are prepared using word processing and graphics software. Data in analyzed using Math Lab.

Laboratory Experiences: Extensive laboratory experience might be required to achieve design project results.

Design Experiences: This is a capstone design course. The entire course is devoted to the solution of an open-ended engineering design project that is to meet stated specifications.

Independent Learning Experiences:

1. Extensive research to complete open-ended design as needed.
2. Formulate experiments and collect data to verify design steps.
3. Write technical reports.
4. Prepare and deliver oral presentations relating to the design process.

Contribution to the Professional Component:
(a) College-level mathematics and basic sciences: 0 credit hours
(b) Engineering Topics (Science and/or Design): 2.5 credit hours
(c) General Education: .5 credit hours
Total credits: 3

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