Summary
Clinical engineering is an important sub-specialty of biomedical engineering focusing primarily on applying engineering principles from biomedical, systems, and management engineering to technology being planned for or existing in the healthcare system. This course will provide an introduction into the field of clinical engineering (CE) with a focus on the CE leadership role as the bridge between technology and medicine in the healthcare system. In addition to the basic foundational aspects of CE, trends and current issues and challenges will be presented. Case studies and student team activities will add to the engagement of students. In addition to the resources of an established, robust clinical engineering program at UVM www.tsp-uvm.org and UVM’s teaching hospital, regional, national and international guest speakers will add to the learning.

Learning Objectives
1. Provide a basic understanding of the clinical engineering profession – qualifications, roles, activities, and expectations.
2. To understand the current trends, challenges and issues in healthcare technology and how clinical engineers can tackle them.
3. To engage the students to work as a team to address projects in clinical engineering.
4. Help students better communicate with clinical and other healthcare staff involved with healthcare technology, administration, and vendors.
5. Develop the student's interest, and prepare them for further study and more advanced application of the principles.

Methods
Classroom instruction will be a mix of presentations on specific topics by the instructor and guest presenters (live or virtual) and group task-based assignments. The student classroom work will involve teams engaging in completing project assignments and making team presentations.

Much of the course materials will be individual articles and web-based content including text, photos, diagrams, flow charts, other figures, video, audio, links to other websites, interactive tools, and other web attributes to deliver content to students. Students should expect to spend 4-6 hours per week on coursework outside of class.

Visits to UVM Medical Center will include both a technological focus on critical care, radiation therapy and information technology along with meetings with clinical engineering, physician, IT, facilities, and/or supply chain leaders.
A textbook is not required - Supplemental textbooks are:


Student Evaluation and Grading

- **Four case study reports and presentations - each 10 points (40 points total)**
  Assignments will include reports on contemporary issues and case studies in healthcare technology and its management. The reports and presentations will be from a team of not more than four students. Research, problem solving, insight, justification of statements, and quality of the report will all be part of the evaluation process. (See Reports paragraph)

- **Two exams - each 15 points (30 points total)**
  A midterm exam will be given covering the first half of the course. A final exam will cover the second half of the course.

- **Five Discussion Questions - each 3 points (15 points total)**
  Discussion questions relevant to the current topic will be presented. Students will provide an answer to the question according to the requirements and also must respond with a constructive response to another student's answer. Generally, each question will be due on Fridays and the response to another student, completing the assignment, will be due on Sundays. The highest grade for the assignment will only be achieved if the student makes an original post/answer to the discussion question, includes a reference* not part of the course content, links or announcements, comments constructively on another student’s post, and also responds to other student’s comments on his/her original post.

- **Five Quizzes - each 3 points (15 points total)**
Final Grades

The letter grade shown corresponds to the final numeric grade

A+ = 97.5 - 100
A  = 92.5 - 97.4
A-  = 90 - 92.4
B+  = 87.5 - 89.9
B   = 82.5 - 87.4
B-  = 80 - 82.4
C+  = 77.5 - 79.9
C   = 72.5 - 77.4
C-  = 70 - 72.4
D   = 60 - 69.9
F   = <60

Reports

Reports should be 10 pages of double spaced text, tables, and diagrams/figures. The report should be completed in MS Word or Adobe PDF.

The sections of the report should include:

- Title page with title, course title, student's name and date
- Table of contents
- Background
- Methods
- Results
- Conclusion
- Bibliography (Minimum of three references external to course materials)

Criteria for grading will be:

1. Organization
2. Presentation
3. Creativity and originality
4. Quality and accuracy
5. Justification of methods and results
6. Format, grammar, spelling, etc.
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<thead>
<tr>
<th>Week</th>
<th>Course Content</th>
<th>Assignment</th>
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| January 13 | 1. Introduction to the course and clinical engineering  
2. Clinical engineering roles and profession  
  - Virtual message from the President, American College of Clinical Engineering | Discussion Board: Introductions |
| January 20 | 1. Medical devices and systems utilized in the modern and future hospital environment  
2. Site visit to UVM Medical Center - Clinical engineering, radiation therapy and information technology services | Quiz 1                |
| January 27 | 1. Convergence of medical devices, telecommunications, and information technology  
2. Medical device network integration & IoT  
  - Message from health technology leadership at the UVM Health Network | Discussion Question 1 |
| February 3 | 1. Clinical engineering role in device and systems design: Case study examples  
2. Health technology planning and management through the life cycle - WHO Collaborating Center at UVM  
  - Virtual message from the director, Medical Devices, World Health Organization (WHO), Geneva | Quiz 2                |
| February 10 | 1. New technology assessment  
2. Classroom group exercise - technology assessment | Discussion Question 2 |
| February 17 | 1. Technology replacement planning  
2. Evaluation of vendor devices for purchase | Quiz 3                |
| February 24 | 1. Classroom group exercise - technology deployment in the hospital  
2. Preparation for presentations | Discussion Question 3 |
| March 2 | 1 & 2 Student presentations: technology assessment and deployment | Reports 1 & 2 due     |
| March 9 | Spring Break                                                                                                                                             |                       |
| March 16 | 1. Project management & deployment of technology  
2. Exam 1 covers all topics thru March 5th | Exam 1                |
| March 23 | 1. Medical technology regulations and standards  
2. Patient safety and incident investigations of adverse events involving medical technology | Discussion Question 4 |
| March 30 | 1. Classroom group exercise – Healthcare Failure Mode and Effects Analysis related to patient safety  
2. Medical equipment quality assurance, maintenance and asset management | Quiz 5                |
| April 6 | 1. Computerized medical equipment management systems  
2. Clinical engineering department setup and operations | Discussion Question 5 |
| April 13 | 1. Service delivery management and supervision of technicians  
2. Medical device cybersecurity assessment and remediation |                       |
| April 20 | 1. Classroom group exercise cybersecurity assessment  
2. Preparations for presentations | Reports 3 & 4 due     |
| April 27 | 1 & 2 Student presentations: Healthcare Failure Mode and Effects Analysis and cybersecurity assessment |                       |
| May 4 | Exam 2                                                                                                                                                |                       |