ME 571: Medical Robotics Spring 2025

Instructor:
Professor Sheila Russo
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Teaching Assistant:
Hyunje Cho
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Course schedule:
Lectures and labs:
Monday and Wednesday 12:20-2:05 (EPC B05)

Prof. Russo's office hours:
Time and location TBD.
If you want to attend office hours, you need to send an email in advance to russos@bu.edu to help with scheduling.

Hyunje Cho's office hours:
Time and location TBD.
If you want to attend office hours, you need to send an email in advance to cho95@bu.edu to help with scheduling.

Inclusion:
I consider this classroom to be a place where you will be treated with respect. Individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences – are welcome. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Absence
It is possible that a student needs to miss class due to a personal situation, an illness or other related situation. Students should inform Prof. Russo via email as soon as possible if they need to miss class to accommodate reasonable solutions.

Textbook:
No textbook is required for this course. The instructor will provide course material.

Course web page:
Blackboard

Prerequisites: Mechanical Design (CAD), Experience in Fabrication, Experience with Programming/Automation, Technical Communication (e.g. writing and presentation). Consent of Instructor.

Course learning objectives:
This course will be composed of lectures, labs, tutorials, and hands-on work.

We will study the design, mechanics, materials, manufacturing, and control of robots and associated technologies for medical applications. We will cover theory on medical robotics and case studies, including examples from medical companies and research groups. This class is aimed toward graduate students in engineering; no medical background is required. We will study and explore design principles of different mechatronic components and systems for medical robots.
This course is designed to give students experience with the initiation of a new research project in the field of medical robotics. This will help them develop hands-on skills in robotics, such as:

- Problem identification, describing motivation and significance
- Prior art searches, performing a literature review
- Strategy and concept generation, developing supporting evidence
- Estimation
- Sketching
- Modeling
- Ergonomics and prototyping
- Data presentation, and oral presentation.

Product development will be on a medical related application: surgical robot, medical robot, wearable device, rehabilitative device, etc.

Instructional Format:
The instructor will provide course material (via Blackboard) in preparation for class (videos, notes, slides, reading assignments, and homework assignments). Students will be required to go through that material and prepare before you come to class.
Class time will be devoted to lectures, graded quizzes, discussion sections (quiz discussion, reading/homework assignment discussion, etc.), Q&A, labs, and hands-on activities.

Policy on labs, hands-on activities, and final project:

- Materials (electromechanical parts, pneumatic components, consumable materials, etc.) to carry on labs and hands-on activities will be provided.
- You will have access to EPIC and EPC B05 (basement of EPIC) to work on labs, hands-on activities, and final projects.
- All materials provided will need to be returned at the end of the semester.
- Lab activities and materials will be coordinated by the teaching assistant (TA). If you have questions, please feel free to reach out via email to the TA and the instructor.
- These materials will also be used to pursue a final hands-on project, based on the contents presented in class. No additional materials and/or components will be provided by the instructor and/or the Department. However, you are allowed to purchase some materials on your own within your group, if you want to.
- Labs, hands-on activities, and final project will be carried out in groups (5 students). Instructor will provide guidelines and specific instructions.

Policy on quizzes:

- We will have regular quizzes to assess your understanding of lectures.
- Quizzes will be done in class via Google forms. Please bring your laptop.
- You are allowed access course materials while doing the quiz.

Grading:
Quizzes (30%)
Participation (5%)
Labs (25%)
Final Project Pre-proposal (10%)
Final Project Report and Presentation (30%)

Homework:
Homework assignments will be announced through Blackboard.

- Due date and time will be specified on the assignment.
- Late homework will **not** be accepted.

Final project presentation:
The final project presentation will take place over an entire class period. Missing the final presentation due to vacation is not excusable. Arrangements will be made on a case-by-case basis for documented emergencies or University conflicts.

Boston University Academic Conduct Code:
Honesty is a core value of Boston University. Any violations of BU academic honesty and integrity standards ***will be pursued*** through appropriate University channels. This includes, but is not limited to: cheating, plagiarism and misrepresentation. If you have any questions as to what constitutes an honor code violation, please ask. ***Ignorance is not an excuse for cheating***. You may access the BU Academic Conduct Code at: http://www.bu.edu/academics/policies/academic-conduct-code/

Accommodations for Students with Documented Disabilities:
If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures http://www.bu.edu/disability/accommodations/

Course Schedule:
The following is an approximate schedule for the course.

Date	Lesson #	Topic
W Jan 22, 2025	1	Introduction to the class, logistics, and expectations
M Jan 27, 2025	2	1) How to do bibliographic research 2) Validation of medical robots 3) Tools for your labs and hands-on projects
W Jan 29, 2025	3	General intro to mechanical side of robotics a) Joints and links b) Actuators c) Sensors d) Workspace **Lab 0**
M Feb 3, 2025	4	Autonomous Medical Robots – 1 a) A bit of history b) ROBODOC

W Feb 5, 2025	5	Autonomous Medical Robots – 2 c) CyberKnife **Lab 1**
M Feb 10, 2025	6	Minimally Invasive Surgery and its open challenges – 1 a) Laparoscopy b) LESS
W Feb 12, 2025	7	Minimally Invasive Surgery and its open challenges – 2 c) Flexible endoscopy d) NOTES **Lab 2**
T Feb 18, 2025	8	Teleoperated Surgical Robots – 1 a) daVinci Surgical System from Intuitive Surgical b) Endowrist c) Evolution of the daVinci platform, daVinci robot patient platform d) daVinci robot surgeon console
W Feb 19, 2025	9	Teleoperated Surgical Robots – 2 e) Ion platform from Intuitive Surgical f) Sport – Titan Medical g) RAVEN h) Monarch Auris i) Transenterix **Lab 3**
M Feb 24, 2025	10	Robots for Laparo-Endoscopic Single-Site surgery (LESS)
W Feb 26, 2025	11	Robots for endoscopy a) Locomotion and navigation with flexible robots b) Manipulation and visualization with flexible robots **Lab 4**
M Mar 3, 2025	12	Continuum medical robots – 1 **Work in class on Report 1**
W Mar 5, 2025	13	No class assigned (work on project) **Lab 5**
M Mar 10, 2024		No class – Spring break
W Mar 12, 2024		No class – Spring break
M Mar 17, 2025	14	Towards robotic catheters **Work in class on Report 1** **1st Report due**
W Mar 19, 2025	15	Robotic catheters – 1 **Lab 6** **Lab 7**
M Mar 24, 2025	16	Robotic catheters – 2, 3

W Mar 26, 2025	17	Rehabilitation and wearable robots – intro and motivation **Lab 8**
M Mar 31, 2025	18	Rehabilitation and wearable robots – hands – 1
W Apr 2, 2025	19	Rehabilitation and wearable robots – hands – 2 **Working on Project 2 in class**
M Apr 7, 2025	20	Rehabilitation and wearable robots – lower limbs **Working on Final Project in class** **2nd Report due**
W Apr 9, 2025	21	Rehabilitation and wearable robots – upper limbs **Working on Final Project in class**
M Apr 14, 2025	22	1) Sterilization processes for medical robots 2) Considerations on materials biocompatibility for medical robots **Final Project Pre-proposal due** **Working on Final Project in class**
W Apr 16, 2025	23	**Working on Final Project in class**
M Apr 21, 2025		No class – Patriots' Day Holiday
W Apr 23, 2025	24	**Working on Final Project in class**
M Apr 28, 2025	25	**FINAL PROJECT PRESENTATION** - **Final Project Report due**
W Apr 30, 2025	26	**FINAL PROJECT PRESENTATION**