ME 571: Medical Robotics Fall 2019

Instructor:
Professor Sheila Russo
Department of Mechanical Engineering
730 Commonwealth Ave., EMA 219
Phone: 617-353-9572
Email: russos@bu.edu

Course schedule:
Lecture: Monday and Wednesday 12:20-2:05 (EPC B05)
Office hours: Wednesdays 2:30 – 3:30 PM (Russo – EMA 219)
for extra hours, please email russos@bu.edu
Please email me at least 24h before indicating what you want to discuss

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, tutorials, and group 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
- Machine elements
- Ergonomics and prototyping
- Data presentation, and oral presentation.

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

Policy on hands-on group project:

- Each group (3-5 students) will be given a budget to purchase consumable materials and other components for the realization of their hands-on projects. They will use the EPIC facility to carry on their activities.
- Product development will be on a medical related application: surgical robot, medical device, wearable device, rehabilitative device, etc.

- Orders must be submitted to Prof. Russo for approval prior to sending the order to the Mechanical Engineering front desk, according to the following procedure:
    - Print out your PO excel file and leave it in my mailbox outside Prof. Russo's office door.
    - You will receive a confirmation email that the order has been approved and signed.
    - You will pick up the PO and bring it to the MechE front desk.
- Each group must designate a person responsible to keep track of the team budget and process orders in collaboration with the Mechanical Engineering front desk.

Grading:
Homework and participation (5%)
Project Pre-proposal (10%)
Midterm 1 (10%)
Midterm 2 (10%)
Final proposal (30%)
Proposal presentation (30%)
Peer review (5%)

Homework:
Homework assignments will be announced in class.

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

Exams:
Each exam will take place over an entire class period.

- Missing an exam 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/

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

Week #	Date	Lesson #	Topic
Week 1	Sep 4, 2019	1	Introduction to the class Project description and expectations Homework description and expectations Midterm and Final exam
Week 2	Sep 9, 2019	2	General intro to mechanical side of robotics a) Joints and links b) Actuators c) Sensors d) Workspace Autonomous Surgical Robots
	Sep 11, 2019	3	Minimally Invasive Surgery and its open challenges **You should have formed teams and agreed on a proposal by 9/10 5pm.** **On 9/11, we will briefly discuss in class teams and assign team numbers.** **Also, you need to agree on a regular schedule when team members will work together.**
Week 3	Sep 16, 2019	4	Teleoperated robots
	Sep 18, 2019	5	1) How to do a bibliographic research 2) Sterilization processes for medical robots 3) Biocompatible and emocompatible materials for medical robots **External speaker - TBD**
Week 4	Sep 23, 2019	6	Robots for Laparoendoscopic single-site surgery and endoscopic platforms **Project preproposal due (1 page, see guidelines discussed in class)**
	Sep 25, 2019	7	Endoscopic capsules a) Passive capsules b) Active robotic capsules c) Motor-driven capsules d) Modular robotic capsules e) Magnet-driven capsules f) Origami capsules
Week 5	Sep 30, 2019	8	**External speaker - TBD**
	Oct 2, 2019	9	**External speaker - TBD**
Week 6	Oct 7, 2019	10	**Review of projects in class - Round table discussions** **Each team presents idea and state of the art (at least one paper per team member)**

	Oct 9, 2019	11	**Review of projects in class - Round table discussions** **Each team presents idea and state of the art (at least one paper per team member)**
Week 7	Oct 15, 2019	12	Continuum robots, snake-like robots, and catheter-like robots - part 1
	Oct 16, 2019	13	Continuum robots, snake-like robots, and catheter-like robots - part 2
Week 8	Oct 21, 2019	14	Midterm - preliminary design and data supporting your idea
	Oct 23, 2019	15	Midterm - preliminary design and data supporting your idea
Week 9	Oct 28, 2019	16	**External speaker - TBD**
	Oct 30, 2019	17	Cooperatively-controlled robots and hand-held robots
Week 10	Nov 4, 2019	18	Rehabilitation and wearable robots - lower limbs
	Nov 6, 2019	19	Rehabilitation and wearable robots - upper limbs
Week 11	Nov 11, 2019	20	1) Rehabilitation and wearable robots - hand 2) Validation of medical robots 3) Ethics in medical robotics - discussion
	Nov 13, 2019	21	The next generation biomedical robots - part 1
Week 12	Nov 18, 2019	22	Midterm
	Nov 20, 2019	23	Midterm
Week 13	Nov 25, 2019	24	The next generation biomedical robots - part 2
	Thanksgiving		No class
Week 14	Dec 2, 2019	25	**Final Project due date** The next generation biomedical robots - part 3
	Dec 4, 2019	26	**External speaker - TBD**
Week 15	Dec 9, 2019	27	Final exam Peer review on final projects are due on 12/10/2019
	Dec 11, 2019	28	Final exam Peer review on final projects are due on 12/10/2019