MIE 443H1S
MECHATRONICS SYSTEMS: DESIGN & INTEGRATION

INSTRUCTOR: Prof. G. Nejat (Course Coordinator) Email: nejat@mie.utoronto.ca

TEACHING ASSISTANTS:

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LECTURES:	Wednesday	2:00 - 4:00 PM	Room: BA1130
LABS:	Tuesday	3:00 - 8:00 PM	Rooms: MY580 (PRA0101) and MY570 (PRA0103)
	Thursday	9:00 AM - 2:00 PM	Rooms: MY580 (PRA0102) and MY570 (PRA0104)

MARKING:	**3** Contests & Corresponding Reports	90% (30% for each contest and corresponding report)
	Discretionary (Unsupervised work including attendance, team work, return of equipment after each lab, etc.)	10%

PREREQUISITE COURSE: MIE346H1 Analog and Digital Electronics for Mechatronics

REFERENCE MATERIAL:

i) TurtleBot Technical Manual for MIE 443H1S

ii) Notes provided by the Instructor

iii) A Gentle Introduction to ROS (https://cse.sc.edu/~jokane/agitr/agitr-letter.pdf)

iv) C++ Tutorials (http://www.cplusplus.com/doc/tutorial/ and from freecodecamp.org https://www.youtube.com/watch?v=vLnPwxZdW4Y&t=8842s)

v) Piazza https://piazza.com/utoronto.ca/winter2020/mie443hs1/

The course aims to raise practical design awareness, provide practical project engineering methodology, and generate core know-how in integration of complex automation. This course has mainly practical content, and is integral and useful in the training and education of those students who plan to be employed in areas related to intelligent automation and robotics, as well as to the breadth of knowledge of all others. Although emphasis will be on robotic-based automation (mechatronics), the learning will be useful in all domains of system integration.

The course will be monitored based on contests and reports, and will be teamwork based. The lectures will be in the format of tutorials and focus on preparation and discussion of project-related issues as well as current technology in the fields of mechatronics and robotics. Emphasis will be on understanding the elements of integration, methodology and approaches. Specifically the course will provide a practical step-by-step approach to integration: specifications, analysis, modeling, synthesis, simulation, integration, verification, and testing. In addition, students will gain physical understanding of the real-world capabilities of mechatronics technologies and tasks that can be achieved by these systems.

Students interested in this course will have completed courses in Electronics, Software, Mechatronics including Control Theory, and have working knowledge of programming in C++. The students are expected to work and communicate in a team format, and be willing to allocate more than average time in the context of team projects.

Learning Outcomes:

1. Specifications of mechatronics/robotic systems
2. Integrated hardware and software design
3. Implementation and validation of mechatronics/robotics systems
4. Physical understanding of real-world capabilities of mechatronics/robotics systems
5. Effective teamwork
6. Professional communication of design activities

Collaboration Policy

Contests will take place in the laboratory sessions. Work for the contests will be done in groups of five students. Students may choose their own groups. Each person in a team will be expected to do his or her own equal share of the work. Once the teams are set at the beginning of the course, please note that there will be no switching or changing of members between teams. So, please choose your team very carefully ☺.

No late submissions will be accepted for contests and reports. All team members must be present (and on time) on the days of the contests for the entire team to receive their respective grades.

Each group is assigned a specific robot and laptop. These are signed out by your group each week at the beginning of your assigned lab session and need to be returned at the end of that lab session. Failure to do so will result in the group receiving a zero on the corresponding contest. Please take care of this equipment as it will be yours for the entire duration of the course.

OUTLINE & SCHEDULE FOR LECTURES:

Date	Lecture	Content
Jan. 8	#1	*Introduction to Course, Mechatronics and Personal Robots*
Jan. 15	#2	*Introduction to Ubuntu and The Robot Operating System (ROS)*
Jan. 22	#3	*Review of C++*
Jan. 29	#4	*Intelligent Control*
Feb. 5	#5	*Robot Tasks and Sensors*
Feb. 12	#6	*Contest #1 (during the lab sessions)*
Feb. 19		*Reading Week*
Feb. 26	#7	*Robot Emotions*
Mar. 4	#8	*Preparation of Contest #2 (during the lab sessions)*
Mar. 11	#9	*Preparation of Contest #2 (during the lab sessions)*
Mar. 18	#10	*Contest #2 (during the lab sessions)*
Mar. 25	#11	*Preparation of Contest #3 (during the lab sessions)*
Apr. 1	#12	*Preparation of Contest #3 (during the lab sessions)*
Apr. 8	#13	*Contest #3 (during the lab sessions)*

OUTLINE & SCHEDULE FOR LABS:

Week	Content
#1 (e.g., Jan. 7th and 9th)	*No Labs This Week. Pick Groups for Contests*
#2 (e.g., Jan. 14th and 16th)	*Familiarization with TurtleBots, Ubuntu and ROS*
#3 (e.g., Jan. 21st and Jan. 23rd)	*Preparation for Contest #1 (Using ROS Nodes and Topics, Gmapping)*
#4 (e.g., Jan. 28th and Jan 30st)	*Preparation for Contest #1*
#5 (e.g., Feb. 4th and 6th)	*Preparation for Contest #1*
#6 (e.g., Feb. 11th and 13th)	*Contest #1 Autonomous Robot Search of an Environment*
	Reading Week
#7(e.g., Feb. 25th and Feb. 27th)	*Preparation for Contest #2 (AMCL and Monte Carlo Localization)*
#8(e.g., Mar. 3rd and 5th)	*Preparation for Contest #2 (OpenCV)*
#9(e.g., Mar. 10th and 12th)	*Final Preparation for Contest #2*
#10(e.g., Mar. 17th and 19th)	*Contest #2 Finding Objects of Interest in an Environment*
#11(e.g., Mar. 24th and 26th)	*Preparation for Contest #3 (Turtlebot Follower)*
#12(e.g., Mar. 31st and Apr. 2nd)	*Final Preparation for Contest #3*
#13(e.g., Apr. 7th and 9th)	*Contest #3 Follow Me Robot Companion*