NORTHWESTERN POLYTECHNIC

DEPARTMENT OF SCIENCE

COURSE OUTLINE –Winter 2023

CS3120 (A3): EXPERIMENTAL ROBOTICS – 3 (3-0-3)
90 Hours for 15 Weeks

Northwestern Polytechnic acknowledges that our campuses are located on Treaty 8 territory, the ancestral and present-day home to many diverse First Nations, Metis, and Inuit people. We are grateful to work, live and learn on the traditional territory of Duncan's First Nation, Horse Lake First Nation and Sturgeon Lake Cree Nation, who are the original caretakers of this land.

We acknowledge the history of this land and we are thankful for the opportunity to walk together in friendship, where we will encourage and promote positive change for present and future generations.

INSTRUCTOR:	**Mohammad Mahdi Hassan**	**PHONE:**	
OFFICE:		**E-MAIL:**	
OFFICE HOURS:	TBA		

CALENDAR DESCRIPTION: A project-based course dealing with the design and implementation of behavior-based robots to accomplish specific tasks. Students work in groups and are introduced to concepts in sensor technologies, sensor data processing, motion control, embedded system design, real-time programming and behavior arbitration.

PREREQUISITE(S)/COREQUISITE: CS2290 or CS3290 (co-requisite)

REQUIRED TEXT/RESOURCE MATERIALS:
The Robotics Primer, Maja J Mataric, MIT Press (recommended). Please order online.

Mobile Robotics for Multidisciplinary Study, Carlotta Berry, Morgan & Claypool Publishers (recommended). Please order the e-book online; print version also available.

Additional readings will be provided

DELIVERY MODE(S): In class lecture

COURSE OBJECTIVES:
The course will provide students an opportunity to integrate knowledge of software and hardware design in the context of building autonomous robots. Students will become extremely familiar with the difficulties

of designing hardware and software which must work in the real world. Construction of working robotic systems will enable students to learn about numerous robot concepts, terminology and embedded systems design techniques. Students will be introduced to:

- Arduino hardware platform and software IDE.
- Numerous sensor, motor, IO and communication shields
- Use of various communication protocols
- Digital and analog circuitry for interfacing with raw sensors and IO devices
- Motion planning/control
- Sensor data processing
- Behavioral robotics

LEARNING OUTCOMES:

Students will be able to:

- Work with the Arduino platform
- Interface an Arduino microcontroller to numerous sensors such as encoders, buttons, photocells, IR ranging sensors, potentiometers, IR sensors, IR reflective photosensors, ToF sensors, sonar, color sensor, and others as available
- Be able to control numerous actuators such as DC motors, servo motors, laser modules, LED, LCD, OLED displays, and relays
- Implement interrupt driven software
- Use I2C, SPI and IR communications
- Use behavioral robotic concepts to control robot functionality

TRANSFERABILITY:

Please consult the Alberta Transfer Guide for more information. You may check to ensure the transferability of this course at the Alberta Transfer Guide main page http://www.transferalberta.ca.

** Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. **Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability**

EVALUATIONS:

35 % -- Lab Assignments/Mini-projects
20 % -- Final Project
10 % -- Log book
35 % -- Final Exam

GRADING CRITERIA: (The following criteria may be changed to suite the particular course/instructor)

Please note that most universities will not accept your course for transfer credit **IF** your grade is **less than C-**.

Alpha Grade	4-point Equivalent	Percentage Guidelines		Alpha Grade	4-point Equivalent	Percentage Guidelines
A+	4.0	90-100		C+	2.3	67-69
A	4.0	85-89		C	2.0	63-66
A-	3.7	80-84		C-	1.7	60-62
B+	3.3	77-79		D+	1.3	55-59
B	3.0	73-76		D	1.0	50-54
B-	2.7	70-72		F	0.0	00-49

COURSE SCHEDULE/TENTATIVE TIMELINE:

Topic	Week
The Arduino platform	1
Actuator control	2
Sensor interfacing	3
Arduino resources including libraries, code examples and tutorials	4
Data storage (flash, Sram, EEprom, SD cards)	5
Communication methodologies (serial, I2C, SPI and IR)	6
Introduction to robotic history, robots and human culture and general terminology	7
Current state of robotics in society as well as potential for future adoption	8
Overview of various sensor technologies	9
Interrupts and interrupt handling	10
Robotic control architectures	11
PID control	12
Behavioral robotics	13
Bluetooth communications	14
Extras	15

STUDENT RESPONSIBILITIES:

- CLASS and LAB attendance are mandatory. You must clear all absences with me; failure to comply will result in a failing grade for the course!

STATEMENT ON PLAGIARISM AND CHEATING:

Cheating and plagiarism will not be tolerated and there will be penalties. For a more precise definition of plagiarism and its consequences, refer to the Student Conduct section of the Northwestern Polytechnic Calendar at https://www.nwpolytech.ca/programs/calendar/ or the Student Rights and Responsibilities policy which can be found at https://www.nwpolytech.ca/about/administration/policies/index.html.

**Note: all Academic and Administrative policies are available on the same page.