Course Outline

FACULTY:	**Faculty of Science and Technology**
PROGRAM(S):	**243.A0 Computer Engineering Technology**
DEPARTMENT:	**247 Computer Engineering Technology**
COURSE TITLE:	**MECHATRONIC AND ROBOTIC SYSTEMS**
COURSE NUMBER:	**247-510-VA**
COURSE SECTION(S):	00001, 00002
PONDERATION:	2h – 3h – 2h
NUMBER OF CREDITS:	2.33 credits
PREREQUISITE(S):	247-511-VA
SEMESTER/YEAR:	Semester 5, Fall 2020
TEACHER (THEORY):	John F. N. Salik, Eng.
	Office: D-366
	Tel: 514-744-7500 Ex. 7034
	E-mail: salikj@vaniercollege.qc.ca
AVAILABILITY:	Office Hours: Tuesday from 1pm to 2pm or by appointment for online meeting via Teams. In-person meetings must be scheduled one week in advance.
TEACHER (LAB):	John F. N. Salik, Eng.
	Office: D-366
	Tel: 514-744-7500 Ex. 7034
	E-mail: salikj@vaniercollege.qc.ca
AVAILABILITY:	Office Hours: See above

Introduction

In this course, students learn to troubleshoot, debug and optimize mechatronic and/or robotic systems using actuators, sensors and controllers. They will write (or use) any software necessary or use electronic/mechanical components for this purpose. They will identify anomalies, diagnose, repair and replace components of robotics and/or mechatronics with the goal of producing at least one functional system. Students will also analyze the system performance to improve it. Student will produce supporting documentation. Students will be introduced to advanced control systems, signal processing and simulation methods.

NOTE: The special topics for online instruction will be Computer Vision and Artificial Intelligence.

Statement of Competency

Competency 037J: To troubleshoot a computerized system.

Competency 037U: To perform activities related to optimizing a computerized system.

Student Personal Resources Required

- Essential materials will be provided by the College.
- Project materials are purchased by the student for projects to a maximum value of $250. Students will be required to provide proof of all purchases to ensure economical purchases.

Bibliography (required according to MEES)

- Class Notes & Slides 2017, John Salik
- To be provided through the online resource.

Course Content

Special Topics: **Computer Vision** (Part I) and **Artificial Intelligence** (Part II). Both are key components of modern robotic systems that employ machine vision. Computer vision focuses deals with how computing systems gain understanding from digital images or video. The goal is to automate tasks that the human visual system can do. Artificial intelligence refers to the simulation of human intelligence in machines for the purpose of automated learning and problem-solving.

Week	Week of	Theory
1	August 24	**Introduction to Computer Vision:** Course Overview, Computer Vision Systems in Robotics, Introduction to Digital Images, Basic Image Processing
2	August 31	**Image Sensing:** Optical Lenses, Sensor Systems Important Considerations when Selecting Image Sensors
3	September 7	**Metrology:** Image Geometry, Aggregate Pixel Measures, Measurement, ROI Processing, Examples
4	September 14	**Filters:** Filters as Functions, Convolution, Filter Design
5	September 21	**Image Processing Pipelines:** Feature and Feature Extraction, 3D Projection, Shape Detection, Image Processing Pipelines
6	September 28	**Machine Vision Software Development:** Introduction to Python Development, Image Processing: Hello World
7	October 5	**Machine Vision Applications in Python:** Case Studies**,** Introduction to Computer Vision (AI)
8	**October 19**	**Midterm**
9	October 26	**Introduction to Artificial Intelligence:** Introduction to AI Development in Python, Data Handling
10	November 2	**Regression & Classification:** Regression, Classification, Clustering
11	November 2	**Stochastic Methods:** Local vs Global Optimization, Genetic Algorithms, The Traveling Salesman Problem
12	November 16	**Reinforcement Learning:** Exploration vs. Exploitation, Bandits, Q-Learning
13	November 23	**Neural Networks:** Feed-Forward Neural Networks Recurrent Neural Networks
14	November 30	**Deep Learning:** Shallow vs. Deep Neural Networks, Important Architectures, Well-Known Pre-trained Networks, Developments in AI
15	December 7	**Final Examination**
16	December 14	Project Workshop

Note1: Dates and content may vary as they are still in development.

Course Structure

THEORY:	2 hours/week:	Students must be present, taking their own notes and actively participating in classroom activities.
LABORATORY:	2 hours/week:	Students must be present and actively participating in the laboratory activity. They must demonstrate clearly that all tasks have been independently completed.
HOMEWORK:	2 hours/week:	Students are expected to devote 2h outside of class time in completing their projects and assignments.

ATTENDANCE

THEORY:	Consistent attendance is required to fully benefit from the course. In the event of absence, students are responsible for obtaining and assimilating all material covered.
LABORATORY:	Failure to complete all lab activities assigned in the designated lab class without just cause may result in a failure of the lab session and any results and/or Lab Report derived from the session. To successfully be evaluated on the course competencies, lab attendance is required.
TESTS:	Absence will result in failure of the missed test (mark of 0). Students with a just cause for absence are encouraged to seek alternative arrangements with the instructor – beforehand if possible.

EVALUATION

	Homework	**10%**	10%	Homework / Participation
	Tests	**45%**	20%	Midterm
			25%	Final
	Projects	**45%**	15%	Assignment 1
			15%	Assignment 2
			15%	Assignment 3
	Total:		**100%**	

The following general rules apply:

- **If log books do not have at least one 500-word entry per laboratory session <u>or</u> if a prototype does not have 100% functionality <u>or</u> the final submitted device does not have at least 80% function <u>or</u> complete documentation is not submitted complete and in the manner requested <u>or</u> the student has demonstrably exceeded their budget, <u>then student will not pass the course (a maximum final grade of 55%).</u>**
- **Students must pass the final to pass the course (failure means a maximum final grade of 55%)**
- At least one week's notice will be given for test dates or changes in test dates.
- Tests questions will not be re-graded after 24 hours of returning and any altered material will not be re--graded
- Quizzes may be given without prior notice – there are no make-ups for quizzes.
- Students are expected to attend all their schedule classes.
    - Absence from any lab class where specific skills are being assessed will result in a failure of that skill.
- **Students are expected to conduct themselves in a professional manner at all times.** This includes but is not limited to:
    - Arriving to class (theory and laboratory) on time and prepared to do the required work;
    - Conducting themselves in an appropriate manner at all times (including being respectful to the teacher, classmates, and any guests);
    - Using professional language (no cursing and/or swearing and using appropriate vocabulary);
    - Arriving to class/lab with all necessary supplies (logbook, notebook, textbook, manual, paper, writing implements, calculator, etc.);
    - Turning off all personal communication/music/video electronics (removing headphones, earphones, ear buds etc.); and
    - Having all assigned work completed.

    Remember that developing professional behaviours and habits now is an important aspect of preparation for entering a professional work environment in the future.
- Students are expected to take their own notes during classes.
- Calculators with memory for equations (for example graphing calculators) will not be allowed when writing tests.
- Reports must be typed and computer generated according to the guidelines provided by the teacher.
- When requested, Lab preparations and Lab Results/logbooks are to be handed in during the lab session. Late Lab Preparations/Lab Results may not be accepted, and a zero mark will be recorded.
- Reports are due two weeks after they are assigned unless the instructor provides a specific due date.
- Any assigned work submitted beyond 1 week late may not be accepted, and a zero mark may be recorded. Assigned work up to and including one week late may be reduced by up to 25% of the maximum mark.
- In-class assignments will only be accepted in the class in which they are assigned.
- Students who are consistently late for class (lab and/or theory) may be refused entry.
- All grades are reported on a numeric scale from 0% to 100%. The following categories briefly describe the relative value of these grades.

range	mean	Description
90 - 100	**95**	Excellent, mastery of the objectives
80 - 89	**85**	Very Good mastery of the objectives
65 - 79	**72**	Good, mastery of objectives
60 - 64	**62**	Fair mastery of objectives
0 - 59	n/a	Poor mastery of objectives

Academic and other Resources

If at any point in the semester, you are concerned about the course or you realise that you are having academic difficulties; your first resource should be to talk to me, your teacher. Academic difficulties include problems with the understanding of the theory, to the development of the practical skills required by the course. The earlier you look for help, the greater your chances of succeeding in the course. If I don't feel I can provide you with the help you need then I may recommend one of the College resources below.

For other problems or difficulties, you may encounter while at Vanier there are a number of Services available to help you within the college. They are there for you to use. These include:

Student Services (C203): Some areas where they provide services and/or information are:

Services for students with disabilities	Counselling (personal and other problems)
Student Advocate	Financial Aid (including aid and scholarships)
Health Services (Nurse on staff)	Student Employment
Academic and Behaviour Policies	Lockers
Housing	Volunteering

Student Services is a great resource for questions about college life and any problems you encounter while at Vanier. If they do not have the answer, they can direct you to the right place to find it.

Tutoring and Academic Success Center - TASC (F-300): Student-orientated centre dedicated to promoting and aiding students' development and success in academics and in society.

Admissions and placement tests	S.T.A.R. Program
English Exit Exam	English conversation and pronunciation clubs
English Peer Tutoring	Scholarship information
Vanier Native Program	Diversity support

TASC is the main college resource for students with learning difficulties and for students with weak English language skills.

Science, Technology, Engineering and Mathematics - STEM (D-301): This Centre aims to promote student success in mathematics and science. The large interactive study space includes a hackerspace for hands-on applied projects such as robotics, and a study hub for collaborative group work. Teacher help, computers, and a large collection of math and science textbooks are equally available. We offer a number of activities, services and resources including:

Free drop-in peer tutoring	Drop-in help from teachers
Free private tutoring	Teacher-led review sessions
Computer access	Laptop borrowing

Mediation and Grades Review

There are two committees available to the student for resolution of academic complaints.
1. The *Grades Review Committee* to review complaints concerning the grading of students' work.
2. The *Faculty Mediation Committee* to review academic complaints other than those dealing with student grades – see *Student Academic Complaints* below.

General College Academic Policies

It is the student's responsibility to be familiar with and adhere to all Vanier College Policies. A summary of the course-level policies that apply in this and all other Vanier courses can be found under "Course-Level Policies" in **Important Vanier Links** on **Omnivox**, or by following this link: http://www.vaniercollege.qc.ca/psi/course-level-policies/. Complete policies can be found on the Vanier College website, under Policies.