

Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 2242b – Principles of Design in Electrical Engineering
Course Outline for 2023-24

Description:

This course provides students with hands-on experience in Electrical Engineering Design Process. The students will learn about the Engineering Design Cycle and will go through all steps of it – from finding the problem, brainstorming different ideas, and choosing the best one, planning the project and its execution, creating and testing a solution, improving the design and finally presenting the results.

Key components of the Arduino microcontroller, different sensors and actuators are introduced, and students will apply this knowledge to the completion of several hands-on laboratory exercises during the first half of the term. The course will enhance the theoretical concepts studied in the second-year courses on electrical and electronic circuits. Also, the students will be introduced to MOSFET switching circuits, DC motor and Servo Motor control circuits.

The above skills will then be used for an electrical design project work during the second half of the term, when students are required to will apply electrical engineering design process and use analysis tools for completion of the electrical design project work. At the end of this course, it is expected that each student will be able to design, build, and test an electronic circuit on PCB (Printed Circuit Board) using Micro-Cap-12 and EAGLE software along with other engineering technical tools.

Instructor:

Dr. Raveendra Rao, P.Eng., SMIEEE
ACEB 4457, 519-661-2111 ext.88231. rrao@uwo.ca

Course Timetable:

Lecture:

Sec 001: Tuesday: 1.30 to 3.30 PM (BGSB-0165)

Laboratory:

Sec 002: Tuesday: 5.30 to 8.30 PM (SEB 3107)

Sec 003: Wednesday: 6.30 to 9.30 PM (SEB 3107)

Sec 004: Monday: 9.30 to 12.30 PM (SEB 3107)

Sec 005: Thursday: 8.30 to 11.30 AM (SEB 3107)

Academic Calendar Copy:

Contact Hours: 2 lecture hours, 3 laboratory hours per week, 0.5 course.

Prerequisites: ECE 2240A, ECE 2277A, ECE 2205A.

Co-requisite: ECE 2231B

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 50%, Engineering Design 50%.

Required Textbook:

The Lab manual and other supplementary manuals will be available in pdf format in OWL website at <https://owl.uwo.ca/portal>. **All of the material for this course will be taught in the lectures and labs; therefore, it is imperative that you attend each lecture and lab.**

Required Software:

You should use Micro-Cap-12 circuit simulation software and download an evaluation copy from: <http://www.spectrum-soft.com>.

For PCB design you should use EAGLE software and download a free evaluation copy from: <https://cadsoft.io/>.

Laboratory Kit:

Students are required to purchase a Laboratory Parts Kit, necessary to complete the labs and the project. The kit contains an Arduino board and multiple sensors and actuators required for the labs and the Project design. The part kits are sold to the students at a nominal cost and must be purchased from the Engineering Stores in TEB. Any replacement or additional part kits will be charged according to their nominal value.

Other Required References:

You may wish to consult the following books to reinforce what is learned in the classroom and lab. Sedra and Smith, Microelectronic Circuits, 6th Edition, Oxford University Press.
Boylestad and Nashelsky, Electronic Devices and Circuit Theory, Canadian Edition, Prentice- Hall.
Irwin and Nelms, Basic Engineering Circuit Analysis, 9th or 10th Edition.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	I	Use of Engineering Tools	A	Impact on Society and the Environment	
Problem Analysis	I	Individual and Teamwork	A	Ethics and Equity	
Investigation	I	Communication Skills	D	Economics and Project Management	I
Design	D	Professionalism		Life-Long Learning	I

I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before; **D** – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course; **A** – It is expected that the student can apply the knowledge without prompting (e. g. no review)

Course Topics and Specific Learning Outcomes	CEAB Graduate Attributes Indicators
<p>1: Engineering Design Principles At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a) Understand the Engineering Design Cycle. b) Plan for their Design Project. 	D1
<p>2: Introduction to Arduino board At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a) Power up, testing the board, loading sketch, update libraries. b) Build an electrical circuits with LED, controlling LED through the Serial Monitor. 	ET1, ET2, KB2
<p>3: Reading Digital and Analog sensors by Arduino At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a) Measuring voltage and angle of rotation of potentiometer. b) Measuring temperature with temperature sensor 	ET1, ET2, KB2
<p>4: MOSFET switching circuits At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a) Design properly biased MOSFET transistor switching circuits; b) Use MOSFET switch to control DC loads – LED and Relay; c) Use Photo-resistor as a light sensor. 	ET1, ET2, KB2
<p>5: Actuators – PWM controlled actuators, Servo motors. At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a) Control the DC actuator by voltage and PWM manually. b) Control the DC actuator by Arduino board – potentiometer PWM control. c) Control the DC actuator by Arduino board – Serial Monitor control. d) Servo motor control by Arduino board. 	ET1, ET2, KB2

6: Project – Open Ended Design Project

Design an electrical circuit, design a Printed Circuit Board using EAGLE software, assemble and test the device, write a formal Report.

At the end of this section, students will be able to:

- a) Implement all stages of the engineering design cycle – from idea to the finished product.
- b) Understand the role of sensors, actuators, control, and machine intelligence in product design. Generate multiple possible solutions using knowledge from different engineering disciplines.
- c) Integrate simple multiple sensors and actuators and develop a microcontroller-based system.
- d) Design and calculate component values of an electrical circuit, simulate it in MicroCap and verify the design. Build the circuit on the breadboard, test, and measure parameters.
- e) TinkerCad project simulation.
- f) Design a Printed Circuit Board using EAGLE software, assemble, test, and troubleshoot the device and write a formal project report.
- g) PowerPoint Presentation and demonstration of the Project

**ET1, ET2, ET3
PA1, PA2, KB2,
KB3, KB4, D2, D3,
D4, ITW1, ITW2,
ITW3, I1-I3, CS2,
EPM1, LL1**

Course Evaluation:

Course Component	Weight
Laboratory Exercises	20%
Design Project	80%

To obtain a passing grade in the course, a minimum mark of 50% in each laboratory exercise with an average of 60% from all laboratory exercises and a minimum of 50% on the project must be achieved.

Laboratory: Four laboratory exercises containing pre-lab, demonstrations to the TA and a lab report due at the end of each lab. No late lab report submission is allowed.

All labs are mandatory! If you missed a lab session, please provide proper documentation to the undergraduate office at your first availability to be allowed for a make-up lab.

Project: This is an open-ended individual or group design project. Each student or group is required to choose a unique problem and provide an Engineering solution to it, design, build and test a microcontroller electrical circuit on a breadboard and simulate it using TinkerCad software, design a PCB, assemble, test and demonstrate the functioning of a finished product, write a formal report and deliver a PowerPoint presentation and demonstration of the project. The details of the project will be distributed in class. The project is completed during the second half of the term and the project report and other deliverables are due at the end of the final lab session. No late project report submission is allowed.

Final Examination: There will be no final examination for the course.

Use of English Policy: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English.

Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance Policy: All classes, laboratories, and tutorials are mandatory unless otherwise stated and the attendance will be taken. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached "Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled"). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Missing the Lab section: Completing all labs in this course is mandatory. If the student misses a lab submission deadline, it's the student's responsibility to contact the ECE Department office and the Course Instructor at the first opportunity (but no later than one week) after the delay and present a valid medical note or other documentations to prove a reasoning for it.

The Course Instructor will schedule a make-up lab at the first available lab time, so the right sequence of the labs will be followed by the student.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Course Delivery with Respect to the COVID-19 Pandemic:

Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The

grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

When deemed necessary, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at: <https://remoteproctoring.uwo.ca>.

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning. All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices:

Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site during lectures and tutorials. Use of *nonprogrammable* calculators *only* is permitted during quizzes and examinations. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services:

Office of the Registrar, <http://www.registrar.uwo.ca/>

Student Development Centre, <http://www.sdc.uwo.ca/>

Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>

USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.