2024

ELG4139: Electronics III

Objectives, Attributes, Content, and Assessment

uOttawa

Faculté de génie
Faculty of Engineering

Riadh Habash, PhD, P.Eng

Course Objectives

This course introduces students to the principles, applications, and developments of two major topics: data acquisition and power electronics systems.
Upon completion, students should be able to:

Recognize, analyze, and solve problems related to the entire domains of data acquisition and power electronics and related technologies.

Develop an awareness of good engineering practices and appreciate professional responsibility while working individually or engaging in a team.

Apply principles of sustainability and interdisciplinary learning in the design of electronic systems.

Improve communication skills by presenting a technical and professional viewpoint on various issues related to electronic engineering.

Develop awareness of global responsibility in matters related to the development and management of data acquisition and power electronics systems.

Recognize the need for life-long learning to stay informed about applicable technical, ethical, legal, and equity standards and practices.

Develop insights about the value of emerging and innovative technologies.

Course Learning Attributes

Knowledge Base

Research

Problem Analysis

Investigation

Design and Sizing

Professionalism

Engineering Tools

Communication Skills

Impact on Society

Project Management

Economics

Codes and Standards

Teamwork

Ethics and Equity

Sustainable Development

Life-long Learning

Course Content

rhabash@uottawa.ca

Module 1: Data Acquisition System

Sensors

Analog Signal Conditioning (Amplifiers and Filters)

Digital Electronics (Multiplexers and Signal Converters)

Module 2: Power Electronics

Switches (Diodes and transistors)

Power Converters (AC/DC; DC/DC; DC/AC); AC/AC)

Applications (Power Supplies and Drivers)

Course Assessment (100 marks)

Lectures: Tuesday 11:30-12:50; Friday 13:00-14:20
Research and Simulation: Thursday 8:30-9:50 (FehmidaSaiyed: fsaiy083@uottawa.ca)
Lab Project: Friday 8:30-11:20 (Qusay AbuBaker: qabub063@uottawa.ca)

Design Modules: 20 marks

Related Simulation Tasks: 10 marks

Tests: 30 marks

(Simulation; Prototype; Educational Video; Article): 40 marks

submissions or presentations are subject to penalties of 25% of assignment grade weight per day. Submissions or presentations five days late or more might receive a zero grade.

Course Design Modules (20 marks)

Riadh Habash: rhabash@uottawa.ca
Submission to BrightSpace

Module 1 (10 marks): IoT-based Data Acquisition System

Submission: October 11, 2024

Format: Submit each task as a "ONE-PAGE e-Poster plus design details in no more than five pages" and combine them into one PDF document.

Test 1 (October 11, 2024): MCQs

Module 2 (10 marks): Sustainable Power Electronics for a More Electric Aircraft

Submission: December 3, 2024

Format: Submit each task as a "ONE-PAGE e-Poster plus design details in no more than five pages" and combine them into one PDF document.

Test 2 (December 3, 2024): MCQs

Design Module 1

Data Acquisition System

Research + Design + Simulation

Submission: October 12, 2024

Define the system under consideration. It may be, for example, a fridge, house, building, robot, disinfection machine, etc. Identify three sensors according to the needs, search manufacturer specification sheets for the specifications, and purchase these sensors for use in the lab project.

- Describe the specification of each sensor.
- Design the signal conditioning circuit (amplifier and filter).
- Design the multiplexer.
- Design the analog-to-digital converter including the sample and hold circuit.

Incorporate your design in one **block diagram** of multiple building blocks, each building block should have a detailed circuit diagram with properly calculated values of components. Define the design criteria and accordingly define the values of components.

Submission: Submit each task as “ONE-PAGE e-Poster plus design details in no more than five pages” and combine all in one PDF document.

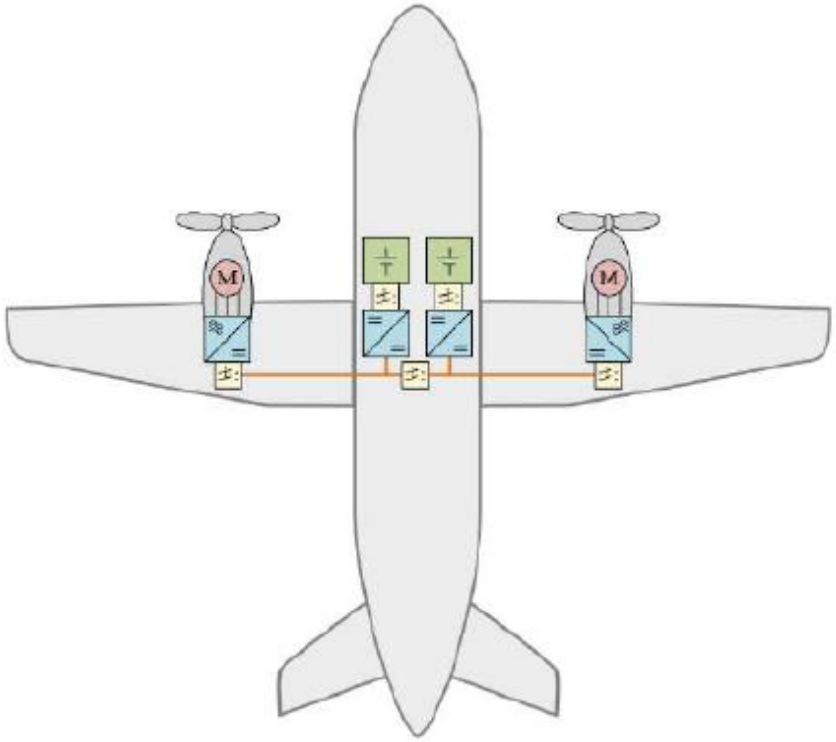
Design Module 2

Sustainable Power Electronics for a More Electric Aircraft

Research + Design + Sizing

Submission: December 1, 2024

Research, design, and size the power electronics system for a solar-powered vertical take-off aircraft of 200 nautical km and 20 seats. The aircraft makes use of two propellers and the associated motors. The two battery stacks are separated from the DC/DC converters, which are housed in the fuselage, by safety switches. The propulsion unit, which consists of the propeller, motor, and inverter, as well as the left and right sides of the aircraft are also isolated from the DC grid by safety switches.



Simulation (15 marks)

TA: FehmidaSaiyed(fsaiy083@uottawa.ca)
Thursday: 8:30-9:50MNO E217

Learn MATLAB (Two Weeks)

https://matlabacademy.mathworks.com/#getting-started

Simulate Design Module 1 (5 marks): October 3 and 10, 2024 in the class

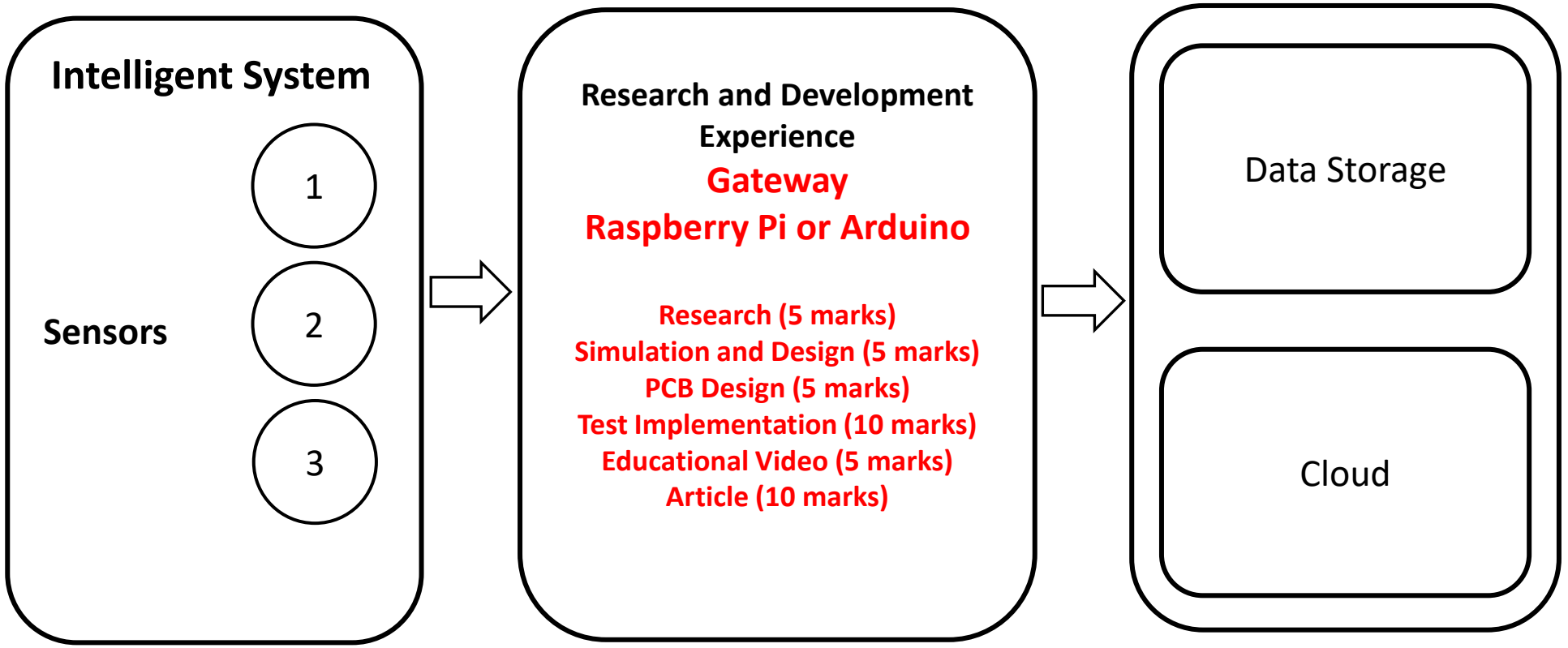
Simulate the Project: October 4 and 11, 2024 in the lab

Simulate Design Module 2 (5 marks): November 21 and 28, 2024 in the class

The above tasks involve demonstration and submission to Brightspace

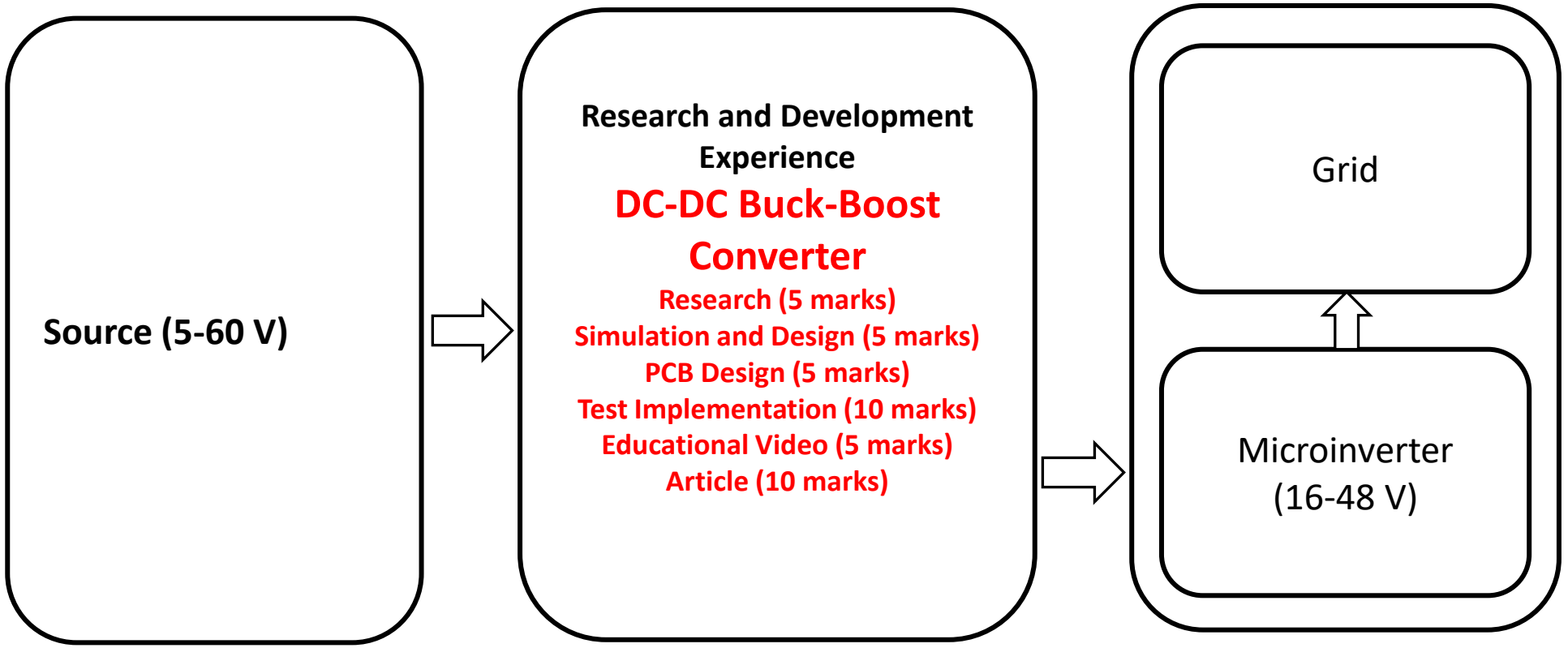
Lab DesignBuild Project (40 marks)

Option 1: This open-ended design thinking project focuses on developing an internet-of-things (IoT)-based sensor system (product) by integrating various sensors into a system and capturing and storing data in a cloud platform for further analysis. A process to turn the system into an INTELLIGENT system should be incorporated.



Lab DesignBuild Project (40 marks)

Option 2: Develop a sustainable DC-DC buck-boost converter for converting energy harvested from a source to supply the electrical grid. Assume the source output is 5V-60 V. The microinverter has an input voltage range from 16V–48 V with maximum efficiency at 36 V.



Lab Project Assessment (35 marks)

TA: Qusay Abubaker (qabub063@uottawa.ca)

Friday: 8:30-11:20

September 13, 2024: Discussion of the project idea with the TA

September 20 and 27, 2024 (5 marks): Demonstration of literature review and the plan

October 4 and 11, 2024 (5 marks): Simulation and Design Demonstration (Fehmida)

November 1 and 8, 2024 (5 marks): PCB design and order

November 22 and 29, 2024 (10 marks): Test Implementation

November 26 and 29, 2024 (5 marks): Educational video presentation in the class

December 4, 2024 (10 marks): Submission of an IEEE article about the project in Brightspace

Project Educational Video (5 marks)

Presentations in the Class: November 26 and 29, 2024.

Pedagogy: Knowledge Translation

The best educational videos are the ones that focus on facilitating learning and/or teaching others.

A top engagement technique is to use conversational language.

- Outline how you want your video to proceed before you start filming.
- Prepare a script before you start the process of editing.

The educational video should include the project idea and possible generated approach.

You may use text, figures, pictures, animation, voice, and/or music.

The duration of the video should be about two minutes.

Avoid in-person presentation style.

What to include? Title, Objective, Idea Conceived, Design, Implementation, and Operation.

Be creative!

Project Article (10 marks)

Submission: December 4, 2024.

TA: Qusay Abubaker (qabub063@uottawa.ca)

This technical communication task involves preparing a manuscript (of about five pages) in a double-column, single-spaced format using a required IEEE *Access* template. The manuscript should reflect your design/build project. Typically, such a document includes the following sections:

Title and names of investigators (students) on the first page
Abstract
Introduction with proper citation
Literature review with proper citation to investigate the project topic. You may need to investigate at least FIVE related articles.
Investigation Details including a block diagram. This may incorporate physical experiments (prototype) and/or simulations that are of value to the community within the area of investigation.
Discussion of the operational outcomes and/or final results.
Conclusion
References
Be reflective!