Course Outline

Professor: Kevin Bradshaw  
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Credit Hours: 3  
Presentation format: Lecture 2 hrs/wk, Lab 3.5 hrs/wk, Seminar 0 hrs/wk  
Prerequisite: ELEN 132  
Co-requisite: None  

Description:
An introduction to computer aided drafting including drawing of block diagrams, schematic diagrams, circuit board layouts and wiring diagrams. High reliability soldering techniques, component selection, circuit board production and wiring harness construction are studied.

Major Topics:
The project will be the design and construction of a PCB and associated wiring to complete a set of sensors for the robotic buggy project started in ELEN 132. This project will require items from all the major topics listed below.

1. IPC standards on soldering  
2. Block Diagrams  
3. Bill of Materials  
4. Schematic Diagrams  
5. PCB design  
6. Thermal Management  
7. Battery Types and Uses  
8. Voltage Regulation  
9. Circuit Design Calculations  
10. Basic Low Voltage Cabling/Wiring

Course Evaluation
The Course Evaluation will be based on the following break-down:

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Term Tests</td>
<td>20%</td>
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<tr>
<td>Assignments/Labs</td>
<td>20%</td>
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<tr>
<td>Project</td>
<td>25%</td>
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<tr>
<td>Soldering</td>
<td>15%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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Assignments

Late assignments will receive a mark of zero.

Course Materials:

Textbook: None
Lab Manual: None

Learning Outcomes:

After completion of this course the student will be able to:
1. Apply IPC Soldering Standards to;
   a. Identify different solder and flux types
   b. Inspect soldering equipment and define care and operation
   c. Describe wetting and cold joints has it relates to the soldering process
   d. Define the 3 states of solder during the soldering process
   e. Identify tip life and proper tip maintenance
   f. Define the soldering process
   g. State the target soldering requirements for the following component types;
      i. Through hole leads (supported and unsupported holes)
      ii. 5 face metalized terminals
      iii. Cylindrical SMT
      iv. Gull wing
      v. J lead
   h. Perform and identify common splices found in the electronics industry
   i. Perform simple trace repair
   j. Rework by removing and replacing standard package types

Lab Projects: Tinning and wire splices
Turret posts and connectors
Through hole resistors
DIP and TO-92 packages
Chip components and MELF packages
SMT IC (Gull wing leads)
SMT IC (J leads)
Rework and repair

Resources: IPC J-STD-001

2. Develop Block Diagrams
   a. Identify the need for a good block diagrams
   b. Create the links between the schematics and block diagrams
   c. Develop a block diagram for each of the robot sensors
   d. Review a block diagram for commercial electronic system (VHF radio)

Lab Project: Sensor Block Diagrams
3. **Define the Bill of materials**
   a. Develop the required information in a bill of materials
   b. Use electronic supplier online catalogs to find part specifications
   c. Find alternate part numbers based on part specifications

Lab Project: OC Bot BOM

4. **Create Schematics for Electronic Systems**
   a. Identify common schematic symbols
   b. Identify common schematic designators
   c. Perform schematic review using net lists
   d. Perform proper schematic layout and component numbering
   e. Use industry recognized CAD program for schematic entry

Lab Projects: Sensor schematics
Resources: Net lists

5. **Create PCB Design for Electronic System**
   a. Define the layers of a PCB
   b. Define production markings required on the PCB
   c. Calculate trace thickness required for current capacity and temperature rise
   d. Calculate footprint patterns based on part dimensions
   e. Perform trace routing
   f. Describe ground/power plane usage
   g. Calculate the inductance of a via

Lab Projects: Prelim PCB design
PCI layout
Resources: IPC-2221
IPC-SM-782
IPC J-STD-001

6. **Utilize Thermal Management Procedures**
   a. State the need for thermal management
   b. Calculate the power dissipated by common linear devices
      i. Voltage regulator
      ii. Transistors
   c. Calculate the temperature rise for a given system
   d. Calculate required heat sink values
   e. Calculate the temperature rise of voltage regulator used on the robot project

Resources: MIC5219 Datasheet

7. **Select Batteries Required for Electronic Projects**
   a. Overview of common battery chemistries
   b. Define primary and secondary cells
   c. List battery specifications used for robot
   d. State need for proper charging method of lithium polymer batteries
   e. Define the charging method used for the robot batteries
   f. Calculate battery charge/discharge times

Lab Project: Main Controller Testing
8. **Design Required Voltage/Current Regulators**
   a. Compare the differences between linear and switch regulators
   b. Name the 3 switching topologies
   c. Use a LM217 to design a voltage and current regulator
   d. Use PCB layout techniques to maximize regulation life

Resources:  
LM217 Datasheet  
MIC5219 Datasheet

9. **Perform Circuit Design Calculation**
   a. Review of main components used on sensors and controller board
   b. Specify load capacitors needed for crystal
   c. Specify decoupling capacitors needed for IC’s
   d. Specify resistors needed for current limiting of LED’s
   e. Demonstrate motor drive circuits
   f. Demonstrate limitations of IR receiver and line tracker

Lab Project:  
Main Controller Testing

Resources:  
MIC5219 Datasheet  
MCP73831 Datasheet

10. **Use Basic Cabling/Wiring knowledge to:**
    a. Develop a wiring table for robot project
    b. Build a wiring harness used for the robot project
    c. Define key terms used for cabling
    d. Select low voltage wiring based on system requirements

Lab Project:  
Main controller wiring  
Sensor assembly, wiring and testing

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**Occupational Health and Safety**

Course requires the use and handling of hazardous materials, all students are required to follow the safety and health guidelines during labs.
ELEN DEPARTMENT POLICIES

ELEN Department Passing Grade Requirements Policy
Students must obtain a passing grade (at least 50%) in both the lecture component and the laboratory component of the course. If the student receives a failing grade (less than 50%) in either the lab or lecture component, the final mark for the whole course will be no more than 50%.

ELEN Department Laboratory Attendance Policy
Attendance of each lab period is mandatory. If a student misses a lab period due to illness, a doctor’s note must be provided. In that case, that lab will not count for or against you. Any student missing three or more labs, regardless of the reason(s) will be awarded a maximum final mark of 49%; you will fail the course overall. Laboratory attendance will be recorded.

ELEN Department Collection of Student Work Policy
This is a requirement of the accreditation process. Samples of student work will be collected during the term. At the end of the semester, each professor is responsible for collecting a complete copy of the best student’s work. This will include class notes, assignments, labs, exams etc. This copy will be archived.

OKANAGAN COLLEGE POLICIES

Okanagan College Academic Misconduct Policy:
Any incidents of academic misconduct, as outlined in the Academic Offences policy in the Okanagan College calendar, may result in a mark of 0% or another consequence permitted by the policy. In cases of severe or repetitive misconduct, the Dean’s office and the College Registrar will be notified and the student may be given a failing grade for the course or a more serious consequence as permitted by the policy, such as expulsion. The Academic Offences policy can be located online at the following link:
http://webapps-1.okanagan.bc.ca/ok/calendar/Calendar.aspx?page=AcademicOffenses

Okanagan College Student Notification of OC Policies:
Okanagan College requires that students are informed of acceptable student conduct specifically relating to OC Student Non-Academic Conduct and Student Academic Offences policies.

Student Non Academic Conduct:

What Is The Disruption Of Instructional Activities?
At Okanagan College (OC), disruption of instructional activities includes student “conduct which interferes with examinations, lectures, seminars, tutorials, group meetings, other related activities, and with students using the study facilities of OC”, as well as conduct that leads to property damage, assault, discrimination, harassment or fraud. Penalties for disruption of instructional activities can include a warning and/or a failing grade on an assignment, examination or course, or possible suspension from OC. The complete policy is available online at:
http://www.okanagan.bc.ca/Assets/Departments+(Administration)/Legal+Affairs/Student+Non-Academic+Conduct+Policy.pdf
Student Academic Conduct:

What Is Cheating?

“Cheating includes but is not limited to dishonest or attempted dishonest conduct during tests or examinations in which the use is made of books, notes, diagrams or other aids excluding those authorized by the examiner. It includes communicating with others for the purpose of obtaining information, copying from the work of others and purposely exposing or conveying information to other students who are taking the test or examination.”

Students must submit independently written work. Students may not write joint or collaborative assignments with other students unless the professor approves it in advance as a group/team project. Students who share their work with other students are equally involved in cheating.

What Is Plagiarism?

Plagiarism is defined as “the presentation of another person’s work or ideas without proper or complete acknowledgement.” It is the serious academic offence of reproducing someone else’s work, including words, ideas and media, without permission for course credit towards a certificate, diploma, degree and/or professional designation. The defining characteristic is that the work is not yours.

“Intentional plagiarism is the deliberate presentation of another’s work or ideas as one’s own.” Intentional plagiarism can be a copy of material from a journal article, a book chapter, data from the Internet, another student, work submitted for credit in another course or from other sources.

“Unintentional plagiarism is the inadvertent presentation of another’s work or ideas without proper acknowledgement because of poor or inadequate practices. Unintentional plagiarism is a failure of scholarship; intentional plagiarism is an act of deceit.”

What Are The Students’ Responsibilities To Avoid Plagiarism?

Students have a responsibility to read the OC Plagiarism Policy and Procedures outlined in the OC calendar, which is available online at:
http://webapps-1.okanagan.bc.ca/ok/calendar/Calendar.aspx?page=AcademicOffenses

“Students are responsible for learning and applying the proper scholarly practices for acknowledging the work and ideas of others.” Students who are unsure of what constitutes plagiarism should refer to the UBC publication “Plagiarism AVOIDED; Taking Responsibility for your Work”. This guide is available in OC bookstores and libraries.

Students must acknowledge the sources of information used on all their assignments. This usually involves putting the authors’ name and the year of publication in parentheses after the sentence in which you used the material, then at the end of your paper, writing out the complete references in a Reference section.

Students are expected to understand research and writing techniques and documentation styles. Unless otherwise directed by the professor, use the American Psychological Association (APA) or Modern Language Association (MLA) style and cite references using the APA guidelines. A copy of the APA manual is available in the OC libraries, and the library website has online resources available on both major citing styles.

What Are The Penalties For Plagiarism And Cheating?

Okanagan College professors may actively monitor student work for plagiarism or cheating and will follow the Okanagan College Policies when an offense is suspected. A student found to have committed an offense may receive a formal letter of reprimand outlining the nature of the infraction, or further disciplinary action depending on the severity of the offense or whether this is a repeat occurrence. The Dean’s Office of the Science, Technology and Health portfolio, along with the College Registrar, record and monitor all reported instances of plagiarism and cheating.