

ECET 292: Design for Manufacturing

Description

Students will study material that emphasizes the relationship of electronic design and manufacturing, including an introduction to CAD/CAM, Resource Management, Thermal Management and various standards. They will also examine design methodology for the various materials and equipment used in the manufacture of electronic products.

Contact Information

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Pre-requisites

One of:

- C in English 12
- C in English First Peoples 12
- C in ENGL 092
- C in ENGL 103
- C in ENGL 130
- C in ENGL 142
- C in ELD 092
- C in ELD 097
- C in ELD 103
- C in ECET 190

And one of:

- C in Pre-calculus 12
- C in Principles of Math 12
- C in MATH 107
- C in MATH 115

And one of:

- C in Physics 11
- C in Physics 101

Course Type

- *Face-to-face fixed-pace instruction generally on campus*
- *Lecture:* 4 Hours per Week **Online**
- *Lab:* 2.5 Hours per Week **Face to Face**
- *Out of Class Work:* 4 to 8 Hours per Week

Credits: 4.0

Intended Learning Outcomes

Upon successful completion of this course, a student will be able to:

- communicate appropriate design documentation
- compare prototype vs. medium vs. large scale manufacturing
- describe the implementation of compliance and safety standards
- demonstrate CAD/CAM techniques using industry standard software
- construct a physical object from a 3D design
- employ strategies for thermal/power/electromagnetic management
- demonstrate the effective use of basic measurement tools
- describe Enterprise Resource Planning principles as they apply to product development and manufacture
- explain the criteria for quality management systems, principles and standards
- demonstrate familiarity with manufacturing processes and equipment
- describe and compare manufacturing materials and their applications
- interpret and apply safety codes and risk management principles

11. Grading System:

- Letter Grades as per Camosun College Policies

IMPORTANT NOTES:

Note:

- Late penalties of **50% and 5% per day** will be applied at the instructor's discretion.
- Lab attendance is **MANDATORY**, failure to attend labs will result in an F grade
- A **20% penalty** will be applied to lab mark for **Late Attendance**
- All labs and assignments must be handed in at least 3 days prior to the final exam
- Lab grades will not be awarded for missed labs without a valid reason for absence and a doctor's note if sick

To Pass

- You must achieve a minimum of 60% on your final exam
- You must have an average of 60% in assignments tests and quizzes
- You must have hand in all lab reports and achieved a min of 60% average
- You must have an overall course mark of 60%.

COURSE EVALUATION:

| | | | |
|-------------|-----|-----------------------|-----|
| Labs | 30% | | |
| Assignments | 5% | Equipment Stewardship | 5% |
| Tests | 20% | Final Exam | 40% |

TEXT BOOKS AND REFERENCES:

- ◆ Text: None
- ◆ All documents will be posted on D2L
- ◆ Web Resources will also be used

Course Outline:

Design Documentation

- Manufacturing
 - PCB fabrication documents
 - Test documents
 - Enclosure Fabrication
- Design Documentation
 - Design Reviews
 - Handover to Manufacturing
 - Over the wall vs Concurrent Design
 - Version Control

Compliance and Safety Standards

- Standards
 - E-Waste
 - CSA, UL, FCC
 - CE (Europe), EU
- Electromagnetic Compatibility - EMC
 - EMC
 - Mutual Recognition Agreements (MRAs)
 - Test Methods
 - Design

CAD/CAM Techniques

- Drawing standards and techniques
 - Review of ECET 190
- Fusion 360
 - Solid Modeling
 - Constraint Driven
 - Tutorials
 - File Formats
- 3D modelling Integration using Altium and Fusion 360 (**Optional Topic**)
 - MCAD <-> ECAD, Mechanical CAD <-> Electrical CAD <-> 3D Printer
 - Supported Data Exchange File Formats
 - Clearance and Tolerance

Measurement Tools (Optional)

- Review measuring tape and callipers
- 3D Scanning Overview
 - File Types
 - Importing to Fusion 360
- CMM

3D Printing

- STL (Standard Triangle Language) and 3MF (3D Manufacturing Format) file formats
- 3D printing approach
- Student drawn parts

Thermal and Power Management

- Thermal Management and Enclosure Design
 - Environmental Testing
 - Thermal Analysis (Optional)
- Power Budget
 - Overall concept
 - Linear vs switching power supplies
- Software tools for analysis: Fusion 360
- Fail-Safe (Optional)
 - General concept
 - Hardware examples
 - Software Examples

Enterprise Resource Planning – The Supply Chain

- Time management in manufacturing
 - Timesheets
 - Labour and product Progress tracking
 - Part Procurement and Inventory
- JIT Manufacturing
- Lean manufacturing principles
 - Toyota Production System
 - Bottlenecks and obstacles
- Project Management
 - Serial and Parallel Processes

Quality Management Systems, Principles and Standards

- ISO
 - Quality management standard basic concepts and language
 - Requirements of a quality management system
 - Environmental management standards

Manufacturing Processes and Equipment

- Electronics Manufacturing
 - Production Fixturing and Tooling
 - PCB Manufacturing
 - Final Assembly
 - Product Acceptance Sampling
- Enclosure Design
 - CNC Machining
 - Human Machine Interface
 - Application
 - Cost
 - Weight
 - Thermal
 - Material
 - Strength
 - Environment
 - IP Ratings (Ingress Protection Markings), Europe
 - NEMA (National Electrical Manufacturers Association), North America
 - Finish

Manufacturing Materials and their Applications

- Metals
 - Steel
 - Stainless
 - Aluminium
 - Titanium
 - Copper
- Plastics and composites
 - Thermoplastic
 - Thermosetting plastic
 - Plastic injection molding
 - Plastic Blow molding
 - Two shot (multi shot) molding
 - Ultrasonic welding
- Fasteners for materials
 - Cost
 - Material dependant
 - Installation
 - Special Tools
 - Self-Clinching Fasteners
 - Metal fasteners for plastic
 - Disassembly
 - Finishing
- Adhesives

Safety Codes

- Electrical Safety Code

Prototype vs. Medium vs. Large Scale Manufacturing

- Principles of Risk Management
- Job vs Batch vs Mass Production
- Design Cautions for Manufacturing:
- Reliability
- Electrical Connectors
- Differences due to location of manufacturer
- Cost reduction
- Time to market
- Part Selection
- Early vendor involvement
- Cultural differences due to location of manufacturer
- Hand loaded Components and Wiring:
- Yield rate
- Offshore Manufacturing Issues
- Quoting Implications
- Design for testing
- Design for Assembly