School of Trades & Technology
Department of Electronics and Computer Engineering

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*
- *Lab: 2.5 Hours per Week*
- *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:

Course completion requires:

- *Lab attendance is **mandatory***
- *All course material must be submitted by the last day of classes*
- *To write the final exam a passing grade (≥ 60%) on all course material must be achieved prior to the final exam*

A Note on Late Material:

- *All late course material is reduced in mark by 40% and then an additional 5% per day*

COURSE EVALUATION:

Labs	30%	Lab Attendance & Punctuality	5%
Assignments	5%	Equipment Stewardship	5%
Tests	15%	Final Exam	40%

TEXT BOOKS AND REFERENCES:

- Text: None
- D2L
- In Class Handouts
- Web Resources

Course Outline:

Design Documentation

- Product Lifecycle
  - Life Cycle Stages
  - Life Cycle Costs
- 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