Introduction to PCB Design I

SYLLABUS

PROGRAM DESCRIPTION

In the highly competitive electronics industry, the knowledge and skills of staff directly responsible for schematic capture and design documentation can have a direct impact on successful design implementation and time to market. The online IPC PCB Fundamentals Course is designed to provide the skills necessary to create schematics that accurately capture the design intent and comply with IPC standards for schematic documentation. Taught by an IPC-certified industry expert with 25+years of experience in the field, the six-week program utilizes interactive webinars, on-demand recorded class sessions, job-specific exercises, and team projects to facilitate mastery of the key concepts required by circuit board designers.

LEARNING AND PERFORMANCE OBJECTIVES

This program is designed to provide circuit board designers with a balanced foundation of theoretical knowledge and practical skills in schematic capture and design documentation. Upon completion, participants will be able to:

- Define and create schematic symbols and PCB footprints that comply with applicable IPC Standards
- Create simple schematics for use in simulation and prototyping applications
- Implement industry best practices for:
    - Schematic capture
    - Hierarchical design implementation
    - Documentation
    - Parts list generation
- Recognize the trade-offs between the different schematic methodologies and when to use each type
- Assess different component types and attachment methods
    - Differentiate when to use each type of component
- Define standard schematic notes
    - Apply best practices in negotiating these terms with customers

COURSE STRUCTURE

- Instructor and participants meet online twice per week from the comfort of their own home.
- Participants can view recorded online sessions to review course content and class discussions.
- Participants apply key concepts to create a real-world design from concept to completion
- All required materials are included in the course. Participants will have free access to a PCB design authoring software program.
- Course materials are accessible 24/7 on the new IPC Edge learning management system.
- The course can be accessed on virtually any device with an Internet connection and major web browser, including Chrome, Firefox, Safari, Edge, and Internet Explorer.

SUPPLEMENTAL MATERIALS (NOT REQUIRED)

- Printed Circuit Handbook – *Clyde F. Coombs* McGraw-Hill
- Right the First Time – Lee W. Ritchey Speeding Edge
- Signal Integrity Issues and Printed Circuit Boards – *Douglas Brooks* Prentice Hall

IPC STANDARDS COVERED (PROVIDED WITH COURSE)

- IPC-2152 STANDARD FOR DETERMINING CURRENT CARRYING CAPACITY IN PRINTED BOARD DESIGN
- IPC-2221 GENERIC STANDARD ON PRINTED BOARD DESIGN
- IPC-2222 SECTIONAL DESIGN STANDARD FOR RIGID ORGANIC PRINTED BOARDS
- IPC-2611 GENERIC REQUIREMENTS FOR ELECTRONIC PRODUCT DOCUMENTATION
- IPC-2612 SECTIONAL REQUIREMENTS FOR ELECTRONIC DIAGRAMMING DOCUMENTATION (SCHEMATIC AND LOGIC DESCRIPTIONS)
- IPC-2612-1 SECTIONAL REQUIREMENTS FOR ELECTRONIC DIAGRAMMING SYMBOL GENERATION METHODOLOGY
- IPC-2614 SECTIONAL REQUIREMENTS FOR BOARD FABRICATION DOCUMENTATION
- IPC-2615 PRINTED BOARD DIMENSIONS AND TOLERANCES
- IPC-4101 SPECIFICATION FOR BASE MATERIALS FOR RIGID AND MULTILAYER PRINTED BOARDS
- IPC-6011 GENERIC PERFORMANCE SPECIFICATION FOR PRINTED BOARDS
- IPC-6012 QUALIFICATION AND PERFORMANCE SPECIFICATION FOR RIGID PRINTED BOARDS
- IPC-7351 GENERIC REQUIREMENTS FOR SURFACE MOUNT DESIGN AND LAND PATTERN STANDARD

- IPC J-STD-001 REQUIREMENTS FOR SOLDERED ELECTRICAL AND ELECTRONIC ASSEMBLIES

COURSE SCHEDULE

WEEK 1 – INTRODUCTION TO PCB DESIGN

Program overview outlining class schedule and options for accessing class material and assignments. An overview of the fundamentals of PCB Design and review of passive components. Session 1 will focus on passive components and basic electrical engineering equations. Session 2 will provide an overview of the fundamentals of PCB fabrication and design.

ASSIGNMENT:

- No assignments in Week 1

WEEK 2 – COMPONENT LIBRARY CONCEPTS

Creation of library components, including schematic symbol and PCB footprint generation, component parameters, and simulation models.

Introduction of the project that will be created over the duration of the course.

INDIVIDUAL ASSIGNMENT:

- Create component library
    - Complete by Week 3, Session 2

WEEK 3 – BASIC SCHEMATIC CONCEPTS

Proper structure and layout of a good schematic. Key concepts include:

- Page sequencing
- Symbol placement
- Net naming
- Power / ground symbols
- IPC standards

INDIVIDUAL ASSIGNMENT:

- Create simple schematic pages
    - Complete by Week 4, Session 2

WEEK 4 – ADVANCED SCHEMATIC CONCEPTS

Advanced schematic concepts, including:

- Port / off-sheet connections
- Circuit reuse
- Design hierarchy
- Circuit simulation
- Net classes
- Design rules
- Multi-channel design
- Differential nets
- Busses / wire harnesses

INDIVIDUAL ASSIGNMENT:

- Complete advanced schematic pages and create design hierarchy. Apply net classes and design rules to schematic pages.
    - Complete by Week 5, Session 2

WEEK 5 – SCHEMATIC DOCUMENTATION

Proper documentation of schematics and review application of IPC-26xx standards.
Key concepts include:

- Use of standard title blocks
- Standard page sequencing
- Readability
- Standard notes
- ECO and revision history
- Annotation methodology
- Design rules
- Parts lists

INDIVIDUAL ASSIGNMENT:

- Format and generate documentation package for design
    - Complete by Week 6, Session 2

WEEK 6 – CONTENT REVIEW AND FINAL EXAM

Class session will focus on content review, submission of final project, and final exam. Session 1 will be review. Session 2 will be final exam.

INDIVIDUAL ASSIGNMENT:

- Complete final design project package and documentation
    - Submit by Week 6, Session 2

FINAL EXAM:

- Complete final exam during Session 2 or a defined exam time during the last week of the course.
- Completion of the program with a score of 70% or higher on the final exam and/or final project is required to earn a certificate of completion.
- Attempts allowed: 2. Grading method: Highest grade.