



Technical Examination Board, Gujarat State, Gandhinagar

Printed Circuit Board Design, analysis and Manufacturing Techniques

Title	ESDM107: Printed Circuit Board Design, analysis and Manufacturing Techniques
Level	Certificate Course
Course Duration	Four Month (Part time) Three Week (Full Time) 120 Hrs (Th. 48 Hrs Pr. 72 Hrs)
Entry Qualification	B.E./B.Tech/Diploma/B.E. Sem.III onward/ Diploma Sem. IV onward (EC/IC/IT/CE or Similar Branch)/ BCA/MCA/B.Sc./M.Sc./Any other graduate(with Physics/IT)

Teaching Scheme:

Sub Code	Subject Name	Teaching Scheme		Examination Scheme				Term Work Marks	Total Marks
		Theory	Practical	Theory Marks	Hrs.	Practical Marks	Hrs.		
ESDM107	Printed Circuit Board Design, analysis and Manufacturing Techniques	4	6	50	2	100	4	25	175

Total Week	= 12	Theory	= 1 hour slot
Total Teaching slot/Week	= 04	Practical	= 2 hour slot
Theory Periods	= 48	Total teaching	10 hours/week (Part-time) 06 hours/day (Full time)
Practical Periods	= 72		

ESDM 107: Printed Circuit Board Design, analysis and Manufacturing Techniques

PCB design is the entire process of creating a Printed Circuit Board (PCB) through collaboration and integration between multiple disciplines and multiple domains which includes electrical, mechanical, software, system, test, and manufacturing.

Without Printed Circuit Boards, our devices would not be able to function. They are essential in connecting different components and allowing for communication between them. Additionally, PCBs help protect these components from damage and interference.

Course Objectives:

After completion of this course students will be able

- Identify the packages of Electronic components, types of PCBs.
- Design PCB for Manufacturing and assembly point of view.
- Apply various methods for manufacturing of PCBs with different materials.
- Apply basic concept of fault finding /repair and rework methods.
- Acquire the basic level knowledge required to understand assembly techniques for leaded and SMDs and use of various tools during assembly.
- Use the methods of soldering of PCBs. material used in soldering process.
- Understand the basic concept of SMD Soldering and understand repair and rework methods.
- Understand the design and manufacturing Techniques of Printed Circuit Boards.

ESDM107 : PRINTED CIRCUIT BOARD DESIGN, ANALYSIS AND MANUFACTURING TECHNIQUES

Unit-1	Printed circuit Board Design
1.1	Study of Packages of Electronic Components
1.2	History of Printed Circuit Boards
1.3	Various types of Printed Circuit Boards-Single Sided Boards, Double Sided Plated through Hole Boards, multilayer Boards
Unit -2	Printed Circuit Board Design Methods
2.1	Rules for single and Double Sided Board
2.2	Schematic diagram Entry in PCB Design tool/S/W
2.3	Layout Design , Routing methods , Guideline for Artwork Generation
2.4	Generation of various Manufacturing Documents/ Output file generation
2.5	Component Library management in PCB Design tool.
Unit -3	Study of Thermal Analysis
3.1	Signal Integrity
3.2	Rule for Design for manufacturing
3.3	Rules for Design for assembly
Unit -4	PCB Manufacturing Techniques
4.1	Film Master generation methods: Study of photographic Film, Exposing and Developing Process.
4.2	Study of various material used in Manufacturing of Printed Circuit Boards and properties of material.
4.3	Cleaning Method of base materials before pattern transfer-Manual and Mechanical Cleaning Methods.
Unit -5	Printed Circuit Board Manufacturing Methods
5.1	Method of Screen Printing for pattern transfer
5.2	Method of Wet film and Dry film for single and Double Sided Board Manufacturing
5.3	Method of Solder-mask and Legend Printings
5.4	Plating and Etching Techniques
5.5	Mechanical methods required in manufacturing of PCBs like punching, drilling, milling and routing.
Unit -6	Study of-Fault Finding methods of PCBs
6.1	Repairing Techniques
6.2	De-soldering techniques, replacement of Component /Solder Pad /Track repairing methods
Unit -7	PCB Assembly Techniques
7.1	Components Preparation Method-Lead Forming methods
7.2	Leaded through hole assembly and Surface Mount Assembly

7.3	Mixed Assembly Techniques of through hole and SMDs
7.4	Manual Assembly method, Semiautomatic and automatic
7.5	Assembly method
7.6	Study of Tools used in assembly process
Unit -8	Study Soldering Techniques
8.1	Materials used in Soldering Process
8.2	Soldering Methods –Manual and Mass soldering Techniques.
8.3	Tools for soldering and de-soldering
8.4	Study of soldering defect and rectification
8.5	Testing for quality Control
Unit -9	Introduction to SMD
9.1	SMD soldering methods
9.2	placing methods of SMDs
9.3	Study of material for SMD soldering
9.4	Rework and Repairing methods

Suggested List of Practical's

Sr. No	Practical Name
1	Identify different Electronics Components like wire, Bus, junction, AC and DC voltage source, current source, probe, Pulse generator, ground, probe etc.
2	Create and save new schematic file to identify different options like wire, Bus, junction, AC and DC voltage source, current source, probe, Pulse generator, ground, probe etc. of circuit simulation software library.
3	Install PCB designing software along with study of basic PCB Terminologies - grid, top & bottom copper, pads, vias, netlists, silkscreen, etc.
4	Create schematic of simple electronics circuitry in PCB designing software or export net-list of the same from simulation software.
5	Perform Component arrangement for Board Layout & perform Manual Routing of the Board.
6	Perform Design Rule Check (DRC) and Electrical Rule Check (ERC) of your board and apply finishing touches to the board by adding copper pours, silkscreen, mounting holes, etc.
7	Generate design files (Gerber files) & Bill of Materials (BOM). Preview your completed PCB design using the online preview tool.
8	Study various PCB fabrication techniques, fabricate PCB using Gerber Files and prepare complete PCB assembly by soldering hardware components, test Circuit board for desired functionality.
9	Make Custom Library component of one PTH (Plating Through Hole) & one SMD (Surface Mount Device) IC.
10	Fabricate a complex electronic circuit (SMD components desirable) on PCB.

Reference books:

- Printed Circuit Boards: Design and Technology, Walter C Bosshart, Tata McGraw-hill
- Printed Circuit Boards: Design, Fabrication, Assembly & Testing, R S Khandpur, Tata McGraw-hill
- Electronic Drafting And Printed Circuit Board Design, James M. Kirkpatrick, Galgotia Publications
- Handbook of Electronics Manufacturing Engineering, Bernard Matisoff, International Thomson Publishing
- Handbook of Electronics Packaging, Charles A. Harper, McGraw- hill
- Electronics Packaging Forum, James E. Morris, Van Nostrand Reinhold
- Electronics Project Design And Fabrication, Ronals A. Reis, Merrill Publishing
- Printed Circuit Boards, Coombs Clyde F., McGraw- hill
- Electronics Engineer's Handbook, Christiansen D ,McGraw- hill
- Printed Circuit Boards: Design Techniques For EMC Compliance Montrose Mark I, IEEE Press Series of Electronics Technology
- The Design & Drafting of Printed Circuits, Darryl Lindsey, Bishop Graphics Inc
- The Design & Drafting of Analog Printed Circuits Board, Darryl Lindsey, Bishop Graphics Inc
- The Design & Drafting of Digital Circuits Boards, Darryl Lindsey, Bishop Graphics Inc

Software/Tool list:

- Open Source/Licensed PCB Layout Design Software e.g. OrCAD, Proteus
- 3 in 1 SMD Rework station
- PCB Making Instruments, Drill Machine, Hand Held electric power drill

Course Reference:

1. Short Term Courses- NIELIT, GoI
2. Short Term Courses- NCVET, GoI