INTERNSHIP REPORT

On
Printed Circuit Board (PCB) Designing Using NI Multisim

Submitted by:
Bojja Divya
Roll No: [23BEC1329]
B.Tech – Electronics and Communication Engineering
Vellore Institute of Technology

Internship Duration: [10/08/2025– 10/09/2025]
Internship Organization: [Surya’s MiB Enterprise]

CERTIFICATE

This is to certify that **Bojja Divya**, a student of Electronics and Communication Engineering at **Vellore Institute of Technology**, has successfully completed the internship on **Printed Circuit Board Designing** at **[Surya's MiB Enterprise]** from **[10/08/2025] to [10/09/2025]**. During this period, the student has demonstrated remarkable enthusiasm, technical expertise, and problem-solving capabilities while working with simulation tools like **NI Multisim**. The practical experience gained is commendable and will significantly benefit the student's academic and professional growth.

DECLARATION

I hereby declare that this internship report titled **“Printed Circuit Board Designing Using NI Multisim”** is a true representation of the work performed by me during the internship at **[Surya’s MiB Enterprise]**. All data, diagrams, observations, and results are original and have not been submitted for academic or professional recognition elsewhere.

Signature: Bojja Divya
Date:13/09/2025

ACKNOWLEDGMENT

I express my deepest gratitude to my internship supervisor **,**whose guidance and encouragement were vital throughout this internship. I am grateful to the faculty at **Vellore Institute of Technology**, who encouraged me to undertake this internship and provided support throughout. I would also like to extend thanks to my family and friends for their constant motivation and unwavering support, which helped me stay focused and achieve the objectives set forth during this internship.

ABSTRACT

This report presents a comprehensive account of my internship experience in PCB designing using **NI Multisim**, an advanced simulation tool. Through extensive experimentation with circuits including BJT amplifiers, MOSFET switching, LED protection circuits, and timing circuits using the 555 timer IC, I explored various aspects of PCB design from component selection to signal analysis, troubleshooting, and optimization.

The internship covered fundamental electronics principles, circuit behavior under varying operating conditions, and the importance of simulation in modern engineering practices. The report further delves into noise analysis, thermal effects, electromagnetic interference (EMI), and power distribution—topics critical in ensuring reliable circuit operation. By analyzing waveform outputs, conducting AC/DC sweeps, and refining designs through simulation, I gained a practical understanding that bridges theoretical concepts with real-world challenges.

The experience has greatly enriched my problem-solving abilities and prepared me for complex circuit design tasks, making me confident in handling both academic and industrial projects in electronics.

TABLE OF CONTENTS

1. INTRODUCTION

In the ever-evolving landscape of electronics, the Printed Circuit Board (PCB) plays a crucial role in interconnecting components and ensuring efficient signal transmission. PCB design is a multidisciplinary process that requires careful consideration of electrical, mechanical, and thermal parameters. The internship at **[Surya's MiB Enterprise]** provided hands-on experience in this domain, allowing me to apply circuit design theories, experiment with real-world problems, and use industry-grade simulation tools to validate and optimize designs.

The focus of this internship was to develop circuit design expertise using **NI Multisim**, which offers a virtual simulation environment conducive to iterative learning. The internship also emphasized the importance of structured documentation, troubleshooting techniques, and analysis of circuit behaviors under various scenarios.

2. OBJECTIVES OF THE INTERNSHIP

The objectives were framed to encompass both learning and practical application:

- Gain deep knowledge of circuit modeling and PCB layout principles.
- Learn the significance of signal conditioning, noise minimization, and thermal management.
- Use **NI Multisim** to simulate complex circuits and analyze waveform outputs.
- Study biasing, amplification, and switching behavior of various components.
- Validate designs under different operating conditions through AC and DC analysis.
- Explore error diagnosis and effective troubleshooting techniques.
- Document each simulation with accuracy, clarity, and engineering best practices.
- Build problem-solving skills, analytical thinking, and attention to detail.
- Prepare for academic research and industry-level projects in electronics design.

---

3. PRINTED CIRCUIT BOARDS: FUNDAMENTALS AND IMPORTANCE

PCBs are widely used in electronics due to their efficiency in organizing circuits, reducing wiring complexity, and ensuring reliability in signal transmission. Understanding PCB fundamentals involves knowing:

- How conductive traces route signals.
- The role of substrate materials like FR4.
- How vias and through-hole connections facilitate multi-layer communication.
- How trace width, spacing, and copper thickness influence current handling.

Furthermore, PCBs enable design compactness, scalability, and reproducibility—making them essential for modern devices ranging from wearables to communication satellites.

---

4. TYPES OF PCBS AND THEIR APPLICATIONS

Single-layer PCBs

Ideal for simple circuits such as power supplies or household electronics.

Double-layer PCBs

Provide additional routing options, suitable for audio circuits, lighting systems, and intermediate complexity devices.

Multilayer PCBs

Used in aerospace, medical instrumentation, and telecommunication equipment where performance, space optimization, and heat management are critical.

Flex PCBs

Used in compact, foldable devices like smartphones and wearable tech.

High-frequency PCBs

Designed to reduce signal loss and EMI in advanced communication systems.

---

5. ELECTRONIC COMPONENTS: THEORY, CHARACTERISTICS, AND MODELING

Resistors

Used for current regulation. Their selection depends on operating voltage, temperature coefficients, and tolerance levels.

Capacitors

Used for energy storage, filtering, and phase shifting. Equivalent series resistance (ESR) and leakage current are critical parameters.

BJTs

Modeled using Ebers–Moll equations, they are vital for amplification and switching tasks.

MOSFETs

Require threshold voltage considerations and are widely used in power regulation circuits.

LEDs

Operate within specific current ranges, with forward voltage drops modeled for simulation accuracy.

555 Timer IC

Generates oscillations and pulse signals using external resistors and capacitors, with timing controlled by the equation:

f=1.44(R1+2R2)Cf = \frac{1.44}{(R_1 + 2R_2)C}f=(R1+2R2)C1.44

6. NI MULTISIM – DETAILED OVERVIEW AND CAPABILITIES

The tool offers:

- Real-time simulations with immediate feedback.
- SPICE-based analysis for accuracy.
- Integrated measurement instruments including virtual oscilloscopes, function generators, and multimeters.
- Automated error detection for design rule violations.
- Exportable data logs for documentation and validation.

7. CIRCUIT DESIGN WORKFLOW

1. Define objectives and select components.
2. Create schematic diagrams using drag-and-drop features.
3. Assign parameters based on manufacturer specifications.
4. Run transient, AC, and DC analyses to observe circuit behavior.
5. Use oscilloscopes and meters to verify signals.
6. Identify faults and iterate design parameters.
7. Document results and prepare validation reports.

8. SIMULATION TECHNIQUES AND DATA ANALYSIS

AC Sweep

Analyzed frequency-dependent behaviors.

Transient Response

Observed real-time circuit reactions to sudden input changes.

DC Sweep

Validated steady-state behaviors under various supply conditions.

Monte Carlo Simulations

Used to predict variations due to manufacturing tolerances.

9. ADVANCED TROUBLESHOOTING AND ERROR RESOLUTION

Common issues included:

- Floating inputs leading to erratic outputs.
- Incorrect resistor values causing overheating.
- Misconfigured simulation parameters causing failed runs.

Solutions involved:

- Reviewing wiring schematics.
- Cross-checking component models.
- Analyzing transient responses for instability signs.

---

10. THERMAL, NOISE, AND ELECTROMAGNETIC INTERFERENCE CONSIDERATIONS

Simulation techniques helped in modeling:

- Power dissipation patterns using thermal maps.
- Noise filtering using bypass capacitors.
- EMI effects from closely routed traces.

Design strategies included optimized trace routing, shielding, and grounding techniques.

11. POWER DISTRIBUTION AND GROUNDING BEST PRACTICES

Simulations reinforced the importance of:

- Using wide ground planes to reduce impedance.
- Proper routing of power lines to avoid hot spots.
- Designing differential pairs to cancel out interference.

12. PROJECT WORK – COMPREHENSIVE STUDY

Each project was treated as a complete design cycle, including theoretical calculations, simulation setup, waveform analysis, troubleshooting, and documentation.

13. WAVEFORM INTERPRETATION AND MATHEMATICAL MODELING

Waveforms were cross-validated against theoretical equations such as:

- Ohm’s Law: V=IRV = IRV=IR
- Kirchhoff’s Voltage Law for loop analysis.
- MOSFET characteristic curves showing drain current vs gate voltage.

14. INDUSTRIAL APPLICATIONS AND CASE STUDIES

Real-world applications included:

- Automotive control circuits using BJTs for amplification.
- LED drivers with overcurrent protection for safety.
- MOSFETs used in high-efficiency power supplies.
- 555 timers in embedded systems and alarm circuits.

15. EDUCATIONAL REFLECTIONS AND PERSONAL GROWTH

The internship improved:

- Analytical thinking.
- Communication through documentation.
- Hands-on experience with industry-standard tools.
- Ability to simulate, test, and optimize circuits with precision.

16. FUTURE SCOPE AND RESEARCH DIRECTIONS

- Multilayer PCB design with EMI considerations.
- Power electronics optimization using simulation.
- Integration of microcontrollers with PCBs.
- Real-time thermal simulation and analysis tools.

17. CONCLUSION

The internship was a transformative experience that connected textbook knowledge to practical challenges. The use of **NI Multisim** helped in designing, simulating, and validating circuits with high accuracy, preparing me for future challenges in electronics engineering.

18. REFERENCES

- Boylestad, R. L., & Nashelsky, L. – *Electronics Devices and Circuit Theory*
- Sedra, A. S., & Smith, K. C. – *Microelectronic Circuits*
- National Instruments – *NI Multisim User Guide*
- Datasheets from manufacturers for BJT, MOSFET, 555 Timer ICs
- Online platforms: All About Circuits, Electronics Tutorials

19. APPENDICES

Appendix A – Circuit Diagrams

(Placeholders for inserting schematic images.)

Appendix B – Simulation Graphs

(Attach screenshots of voltage, current, and frequency analyses.)

Appendix C – Datasheets

(Include manufacturer specifications and model parameters.)

Appendix D – Mathematical Modeling Tables

Circuit	**Parameter**	**Equation**	**Observed Value**	**Remarks**
BJT Amplifier	Gain	IC=βIBI_C = \beta I_BIC=βIB	5	Matches theoretical expectations
LED Circuit	Current	I=Vsupply−VLEDRI = \frac{V_{supply} - V_{LED}}{R}I=RVsupply −VLED	20 mA	Safe operation
MOSFET	Threshold	VGS(th)V_{GS(th)}VGS(th)	2.1 V	Within tolerance
555 Timer	Frequency	f=1.44(R1+2R2)Cf = \frac{1.44}{(R_1 + 2R_2)C}f=(R1+2R2)C1.44	1 Hz	Stable output