

# HDL Mini Booklet

## HDL Mini Booklet

A Quick Reference Guide for Students

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### 1. Introduction to HDL

Hardware Description Language (HDL) is used to model and simulate digital circuits. It allows developers to describe the structure and behavior of electronic components, making it easier to build and test logic-based systems before physically implementing them.

### 2. Basic Syntax & Structure

An HDL file describes a circuit using a CHIP block.

```
CHIP And {  
    IN a, b;  
    OUT out;  
  
    PARTS:    And(a=a, b=b,  
out=out);  
}
```

### 4. Logic Gates in HDL

Basic logic gates can be directly described using HDL code.

```
CHIP And {  
    IN a, b;  
    OUT out;    PARTS:  
And(a=a, b=b, out=out);  
}  
CHIP Nand {
```

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```
IN a, b;

OUT out;    PARTS:
Not(in=And(a=a, b=b),
out=out);
}
```

## 7. Building Circuits

Examples of combining gates:

```
CHIP HalfAdder {
    IN a, b;
    OUT sum, carry;
PARTS:
    Xor(a=a, b=b, out=sum);
And(a=a, b=b, out=carry);
}
```

```
CHIP FullAdder {
    IN a, b, cin;
    OUT sum, cout;
PARTS:
    HalfAdder(a=a, b=b, sum=halsum, carry=halcarry);
HalfAdder(a=halsum, b=cin, sum=sum, carry=ha2carry);
Or(a=halcarry, b=ha2carry, out=cout);
}
```

## 10. Simulation Tips

- Use the HDL simulator to load .hdl files and test with .tst scripts.
- View results in the output and compare with .cmp files.
- Always validate edge cases (e.g., all 0s, all 1s).

## 11. Mini Project: 2-bit Multiplier

Challenge: Build a chip that takes two 2-bit inputs and outputs a 4-bit product.

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Hint: Use Full Adders and bitwise ANDs to create partial products and add them.

## 12. Hacker Tips

- - Reuse components like HalfAdders and Mux.
- - Think in binary logic and visualize the truth table first.
- - Debug step-by-step using output probes.

## 13. Quiz & Challenges

1. What does a NAND gate do?
2. How would you implement a 4:1 multiplexer?
3. Build a 3-bit binary counter.
4. Convert decimal 13 into binary.
5. Write HDL for a NOT gate using only NAND.

## 14. Summary

This booklet serves as a quick-reference guide for HDL learners. It features real code examples, mini projects, and quiz challenges to reinforce understanding and inspire experimentation.