

Testbench

- 考试要求：
 1. 能画出测试结果的波形
 2. 写Testbench程序
- Testbench is a kind of VHDL Program
- Procedures using testbench
 - Design Under Test instantiation
 - Stimulus generation
 - Apply the stimulus on DUT and observe its response
 - Compare the response with the expected result
- Non-synthesisable codes: cannot be translated to circuit, but are useful for testbench
 - Wait
 - While Loop
 - Infinite Loop
 - File input/output

Structure of Testbench

1. Lib calling
2. Package calling
3. Entity
 - **the entity of testbench is empty**
4. Architecture
 1. Component(DUT) Instantiation: Use component statements
 2. Signal Declaration
 3. DUT Port Mapping
 4. Stimulus Generations: Use process statements

Process Without Sensitivity Lists

- A process without a sensitivity list will keep executing in a loop, but its execution can be controlled using wait statements
- The wait statement suspends a process for a given periods of time(limited or forever) after which the process wakes up with status where it left off

Stimulus Generation

Clock Signal

- Types:
 - symmetric(duty ratio = 50%)
 - asymmetric

```
SIGNAL clk1,clk2: std_logic;  
clk1_gen:PROCESS
```

```
CONSTANT clk_period: TIME:= 40 ns;  
BEGIN  
  clk1 <= '1';  
  WAIT FOR clk_period/2;  
  clk1 <= '0';  
  WAIT FOR clk_period/2;  
END PROCESS;
```

-复习2 ppt130并行语句产生多种信号，注意初值指定方式

Reset Signal

```
SIGNAL reset1,reset2: std_logic;  
--reset1使用绝对时间，里面的时间表示绝对时刻  
reset1 <= '0','1' AFTER 60 ns,'0' AFTER 100 ns;  
--reset2使用相对时间，里面的时间表示每一段时间的长度  
reset2_gen:PROCESS  
BEGIN  
  reset2 <= '0';  
  WAIT FOR 20 ns;  
  reset2 <= '1';  
  WAIT FOR 40 ns;  
  reset2 <= '0';  
  WAIT:  
END PROCESS;
```

Complex Periodic Signal

- Same as the reset signal

Correlated Signals

- Use attributes delay

```
--period2相比period1有10ns的延时  
SIGNAL period1,period2: std_logic;  
...  
period1 <= '0','1' AFTER 60 ns,'0' AFTER 100 ns;  
period2 <= period1'delayed(10ns);
```

General Stimulus

- Use wait and process
- Aims to cover all possibilities of inputs
- Make use of for loop复习2p138

Typical Errors

- Assignments to the same signal in different processes are not recommended. It may introduce assignment conflicts, and cause uncertain states.