TEKNISKA HÖGSKOLAN I LINKÖPING
Institutionen för datavetenskap
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Tentamen i kursen

TDTS 01 Datorstödd elektronikkonstruktion

(Examination on TDTS01 Computer Aided Design of Electronics)

2011-08-24, kl. 8-12

Hjälpmedel:

Engelsk ordbok.

Poänggränser:

Maximal poäng är 40.
För godkänt krävs 20 poäng.

Supporting material:

English dictionary.

Points:

Maximum points: 40.
You need 20 points to pass the exam.

Jourhavande lärare (Teacher on duty):

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Lycka till (Good Luck)!

Note: You can give the answers in English or Swedish.

1. Give a short definition for each of the following terms:
   a) Platform-based design.
   b) Redundant faults.

   (2 p)

2. What is the basic idea of the Describe-&-Synthesize paradigm for electronic design? What are advantages and disadvantages of this design paradigm? How does this design paradigm deal with the increasing complexity of electronic systems?

   (3 p)

3. a) Describe the force-directed scheduling algorithm.
   b) Use a simple example to illustrate the basic idea of this algorithm.
   c) What are the advantages and disadvantages of this algorithm, respectively?

   (3 p)

4. a) What is the basic idea of the transformational approach to the different high-level synthesis tasks?
   b) Describe the transformational approach to the allocation/binding problem.
   c) What are the advantages and disadvantages of the transformational approach?

   (3 p)

5. a) Describe the microcode-based approach for control-unit synthesis.
   b) What are the differences between horizontal microcodes and vertical microcodes? What are their respective features?

   (3 p)

6. a) Describe the three genetic operators that are used to generate new solutions in the next generation of a Genetic Algorithm (GA). Illustrate the operators with simple examples.
   b) Identify an optimization problem in high-level synthesis which is suitable for GA, formulate it formally, and discuss how it can be solved with the GA technique.

   (4 p)

Note: You can give the answers in English or Swedish.

7. a) What are the basic idea of a DFT technique?
b) Describe the characteristics of the structural DFT techniques. What are the main advantages of such techniques?
c) Discuss one structural DFT technique in details and use a simple example to illustrate the advantages of this technique.

(4 p)

8. a) Discuss the store-and-generate technique in the context of BIST. What can it be used for?
b) Give an example to show how this technique works.

(3 p)

The VHDL Part:

9. The VHDL simulation cycle.
a) Describe the successive steps of the cycle.
b) What do we call a delta cycle? When does such a cycle appear?

(3 p)

10. What is special about guarded signals?
We have guarded signals of class register and bus. What is the difference between them?

(3 p)

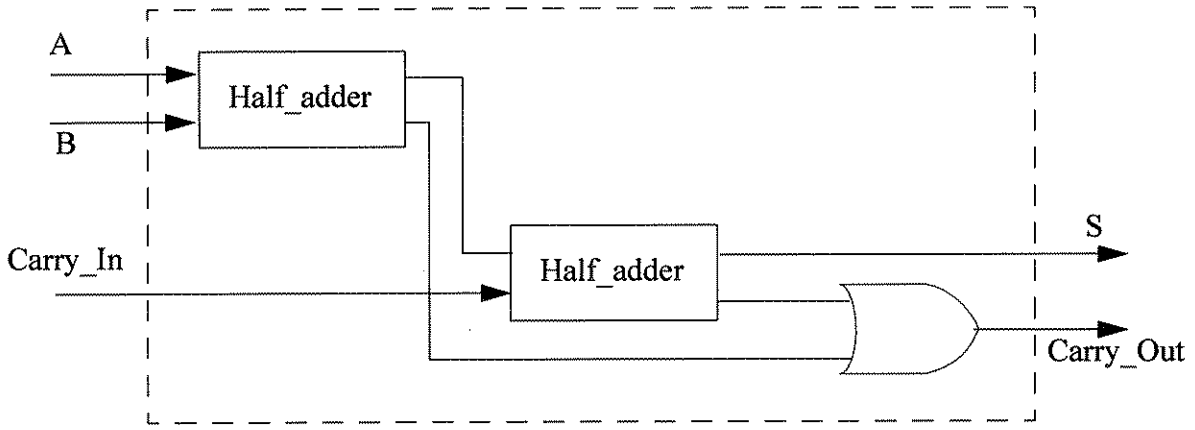
11. We have discussed the following design units a VHDL model is composed of: entity declaration, architecture body, configuration declaration.

Explain which aspect of the model (or of a part of the model) does each of them capture. (What information regarding the model and its simulation do they carry?).
Illustrate by an example for each of them, considering a simple circuit.

(3 p)

Note: You can give the answers in English or Swedish.

12. In the figure below you see how a full adder is built out of two half adders and an OR gate.

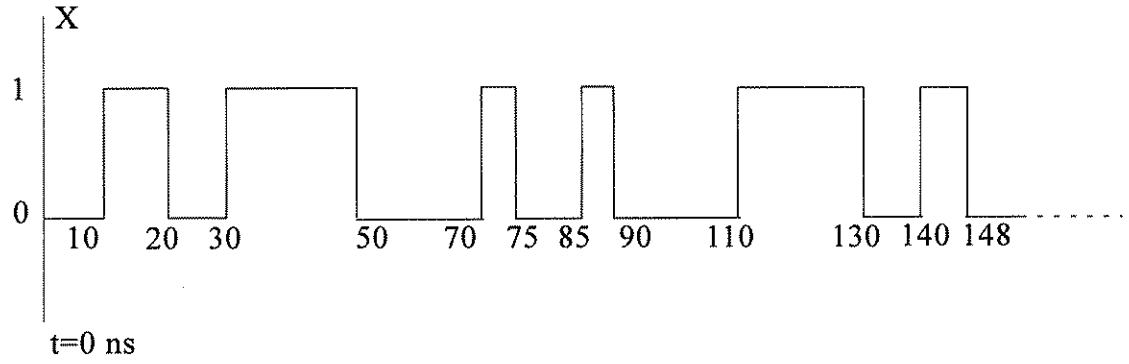


a) Give the entity declarations corresponding to the half adder, the OR gate and the full adder.

b) Give the architecture body corresponding to a structural specification of the full adder.

(3 p)

13. Consider the signal X having the waveform as follows:



Draw the output waveform (Z) if X is applied at the input of a buffer element specified as:

a) Z <= transport X after 15 ns

b) Z <= X after 15 ns

c) Z <= reject 7 ns inertial X after 25 ns

(3 p)

QUALIS
DESIGN CORPORATION

VHDL QUICK REFERENCE CARD

REVISION 1.0

()	Grouping	[ ]	Optional
{}	Repeated	|	Alternative
bold	As is	CAPS	User Identifier
italic	VHDL-1993		

1. LIBRARY UNITS

```
[{use_clause}]
entity ID is
  [generic ({ID : TYPEID [:= expr];});]
  [port ({ID : in | out | inout TYPEID [:= expr];});]
  [{declaration}]
[begin
  {parallel_statement}]
end [entity] ENTITYID;

[{use_clause}]
architecture ID of ENTITYID is
  [{declaration}]
begin
  [{parallel_statement}]
end [architecture] ARCHID;

[{use_clause}]
package ID is
  [{declaration}]
end [package] PACKID;

[{use_clause}]
package body ID is
  [{declaration}]
end [package body] PACKID;

[{use_clause}]
configuration ID of ENTITYID is
for ARCHID
  [{block_config | comp_config}]
end for;
end [configuration] CONFID;

use_clause::=
  library ID;
  [{use LIBID.PKGID.all;}]

block_config::=
  for LABELID
    [{block_config | comp_config}]
  end for;
```



```
comp_config::=
  for all | LABELID : COMPID
    (use entity [LIBID.]ENTITYID [( ARCHID )]
      [[generic map ( {GENID => expr ,} )]
       port map ({PORTID => SIGID | expr ,})];
    [for ARCHID
      [{block_config | comp_config}]
    end for;]
    end for;) |
    (use configuration [LIBID.]CONFID
      [[generic map ({GENID => expr ,})]
      port map ({PORTID => SIGID | expr,})];)
  end for;
```

2. DECLARATIONS

2.1. TYPE DECLARATIONS

```
type ID is ( {ID,} );

type ID is range number downto | to number;

type ID is array ( {range | TYPEID ,})
  of TYPEID | SUBTYPID;

type ID is record
  {ID : TYPEID;}
end record;

type ID is access TYPEID;

type ID is file of TYPEID;

subtype ID is [RESOLVFCTID] TYPEID [range];

range ::=
  (integer | ENUMID to | downto
   integer | ENUMID) | (OBJID'[reverse_]range) |
  (TYPEID range <>)
```

2.2. OTHER DECLARATIONS

```
constant ID : TYPEID := expr;

[shared] variable ID : TYPEID [:= expr];

signal ID : TYPEID [:= expr];

file ID : TYPEID (is in | out string;) |
  (open read_mode | write_mode
   | append_mode is string;)

alias ID : TYPEID is OBJID;

attribute ID : TYPEID;

attribute ATTRID of OBJID | others | all : class
  is expr;

class ::=
  entity | architecture | configuration |
  procedure | function | package | type |
  subtype | constant | signal | variable |
  component | label
```



```
component ID [is]
  [generic ( {ID : TYPEID [:= expr];} );]
  [port ({ID : in | out | inout TYPEID [:= expr];});
end component [COMPID];

[impure] function ID
  [( [[constant | variable | signal] ID :
    in | out | inout TYPEID [:= expr];})]
  return TYPEID [is
begin
  {sequential_statement}
end [function] ID];

procedure ID[({[[constant | variable | signal] ID :
              in | out | inout TYPEID [:= expr];})]
[is begin
  [{sequential_statement}]
end [procedure] ID];

for LABELID | others | all : COMPID use
  (entity [LIBID.]ENTITYID [( ARCHID )]) |
  (configuration [LIBID.]CONFID)
    [[generic map ( {GENID => expr,} )]
     port map ( {PORTID => SIGID | expr,} )];
```

3. EXPRESSIONS

```
expression ::=
  (relation and relation) |
  (relation or relation) |
  (relation xor relation)

relation ::=    shexpr [relop shexpr]

shexpr ::=      sexpr [shop sexpr]

sexpr ::=       [+|-] term {addop term}

term ::=        factor {mulop factor}

factor ::=
  (prim [** prim]) | (abs prim) | (not prim)

prim ::=
  literal | OBJID | OBJID'ATTRID |  OBJID({expr,})
  | OBJID(range) | ({[choice {| choice}] =>] expr,})
  | FCTID({[PARID =>] expr,}) | TYPEID'(expr) |
  TYPEID(expr) | new TYPEID['(expr)] | ( expr )

choice ::=      sexpr | range | RECFID | others
```

3.1. OPERATORS, INCREASING PRECEDENCE

logop	**and | or | xor**
relop	**= | /= | < | <= | > | =>**
shop	***sll | srl | sla | sra | rol | ror***
addop	**+ | - | &**
mulop	*** | / | mod | rem**
miscop	**** | abs | not**

4. Sequential Statements

```
wait [on {SIGID,}] [until expr] [for time];
assert expr
  [report string] [severity note | warning |
                              error | failure];
report string
  [severity note | warning | error |
            failure];
SIGID <= [transport] | [reject TIME inertial]
        {expr [after time]};
VARID := expr;
PROCEDUREID[({[PARID =>] expr,})];
[LABEL:] if expr then
  {sequential_statement}
{{elsif expr then
  {sequential_statement}}}
[else
  {sequential_statement}]
end if [LABEL];
[LABEL:] case expr is
{when choice {| choice}} =>
  {sequential_statement}}
end case [LABEL];
[LABEL:] [while expr] loop
  {sequential_statement}
end loop [LABEL];
[LABEL:] for ID in range loop
  {sequential_statement}
end loop [LABEL];
next [LOOPLBL] [when expr];
exit [LOOPLBL] [when expr];
return [expression];
null;
```

5. Parallel Statements

```
[LABEL:] block [is]
  [generic ( {ID : TYPEID;} );
     [generic map ( {GENID => expr,} );]]
  [port ( {ID : in | out | inout TYPEID } );
     [port map ( {PORTID => SIGID | expr,} );]]
  [{declaration}]
begin
  [{parallel_statement}]
end block [LABEL];
[LABEL:] [postponed] process [( {SIGID,} )]
  [{declaration}]
begin
  [{sequential_statement}]
end [postponed] process [LABEL];
[LBL:] [postponed] PROCID({[PARID =>] expr,});
[LABEL:] [postponed] assert expr
  [report string] [severity note | warning |
                              error | failure];
[LABEL:] [postponed] SIGID <=
  [transport] | [reject TIME inertial]
  [{{expr [after time]} / unaffected when expr
   else}] {expr [after time]} | unaffected;
[LABEL:] [postponed] with expr select
  SIGID <= [transport] | [reject TIME inertial]
     {{expr [after time]} |
      unaffected when choice [{| choice}]};
LABEL: COMPID
     [[generic map ( {GENID => expr,} )]
      port map ( {PORTID => SIGID,} )];
LABEL: entity [LIBID.]ENTITYID [(ARCHID)]
     [[generic map ( {GENID => expr,} )]
      port map ( {PORTID => SIGID,} )];
LABEL: configuration [LIBID.]CONFID
     [[generic map ( {GENID => expr,} )]
      port map ( {PORTID => SIGID,} )];
LABEL: if expr generate
  [{parallel_statement}]
end generate [LABEL];
LABEL: for ID in range generate
  [{parallel_statement}]
end generate [LABEL];
```

6. Predefined Attributes

TYPID'base	Base type
TYPID'left	Left bound value
TYPID'right	Right-bound value
TYPID'high	Upper-bound value
TYPID'low	Lower-bound value
TYPID'pos(expr)	Position within type
TYPID'val(expr)	Value at position
TYPID'succ(expr)	Next value in order
TYPID'prec(expr)	Previous value in order
TYPID'leftof(expr)	Value to the left in order
TYPID'rightof(expr)	Value to the right in order
TYPID'ascending	*Ascending type predicate*
TYPID'image(expr)	*String image of value*
TYPID'value(string)	*Value of string image*
ARYID'left[(expr)]	Left-bound of [nth] index
ARYID'right[(expr)]	Right-bound of [nth] index
ARYID'high[(expr)]	Upper-bound of [nth] index
ARYID'low[(expr)]	Lower-bound of [nth] index
ARYID'range[(expr)]	'left down/to 'right
ARYID'reverse_range[(expr)]	'right down/to 'left
ARYID'length[(expr)]	Length of [nth] dimension
ARYID'ascending[(expr)]	*'right >= 'left ?*
SIGID'delayed[(expr)]	Delayed copy of signal
SIGID'stable[(expr)]	Signals event on signal
SIGID'quiet[(expr)]	Signals activity on signal
SIGID'transaction[(expr)]	Toggles if signal active
SIGID'event	Event on signal ?
SIGID'active	Activity on signal ?
SIGID'last_event	Time since last event
SIGID'last_active	Time since last active
SIGID'last_value	Value before last event
SIGID'driving	*Active driver predicate*
SIGID'driving_value	*Value of driver*
OBJID'simple_name	*Name of object*
OBJID'instance_name	*Pathname of object*
OBJID'path_name	*Pathname to object*

7. Predefined Types

BOOLEAN	True or false
INTEGER	32 or 64 bits
NATURAL	Integers >= 0
POSITIVE	Integers > 0
REAL	Floating-point
BIT	'0', '1'
BIT_VECTOR(NATURAL)	Array of bits
CHARACTER	7-bit ASCII
STRING(POSITIVE)	Array of characters
TIME	hr, min, sec, ms, us, ns, ps, fs
DELAY_LENGTH	*Time => 0*

8. Predefined Functions

NOW	Returns current simulation time
DEALLOCATE(ACCESSTYPOBJ)	Deallocate dynamic object
FILE_OPEN([status], FILEID, string, mode)	*Open file*
FILE_CLOSE(FILEID)	*Close file*

9. Lexical Elements

```
identifier ::= letter { [underline] alphanumeric }
decimal literal ::= integer [. integer] [E[+|-] integer]
based literal ::=
        integer # hexint [. hexint] # [E[+|-] integer]
bit string literal ::=B|O|X " hexint "
comment ::=      -- comment text
```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