Norwegian University of Science and Technology

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

MID-TERM EXAM
TDT4258 MICROCONTROLLER SYSTEM DESIGN

Tuesday 6th May 2008

Time: 1025 - 1155

Allowed material: D: No printed or handwritten material
Specific, simple calculator allowed

Use the table provided on the final sheet to provide your answers

Set type english_E

Correct answer: 2 points
Wrong answer: -0,5 points
Unanswered: 0 points
Multiple answers on one question: -0,5 points!

The mid-term yields a maximum of 20 points, which are then recalculated to account for 30% of the final grade.

ANSWERS ARE TO BE SUBMITTED ON A SEPARATE SHEET ATTACHED AS THE FINAL PAGE

a) The Top-down design process is a method to keep the design complexity at manageable abstraction levels. A Top-down process enables designs of complex components and systems. What are the main abstraction levels in a Top-down design process?

A1. Requirements, specification, architecture, components and system integration
A2. Specification, performance evaluation, power consumption, test method and system integration
A3. Specification, performance evaluation, power consumption, system integration and manufacturing cost
A4. Specification, functional requirements, nonfunctional requirements, physical requirements and manufacturing cost
A5. Specification, hardware design, software design, testing, manufacturing

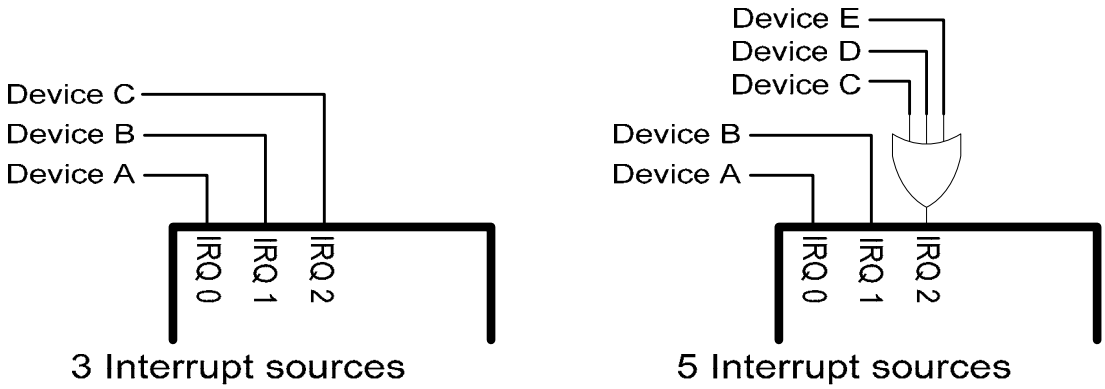
b) Yield and Field return are two important terms considering manufacturing of components and systems. What description is the valid one for Yield and Field return?

B1. Yield: portion of devices with fault. Field return: number of devices that include a fault after a short time of operation.
B2. Yield: portion of devices without fault. Field return: defective unit that leaves the factory
B3. Yield: number of devices including hidden faults. Field return: devices leaving the factory with faults
B4. Yield: portion of devices without fault. Field return: number of corrected faults
B5. Yield: faults covered by the fault model. Field return: faults not covered by the fault model

c) Which one of the following claims considering System-on-Chip (SoC) is **not** correct?

C1. Observability for testing and debugging in a SoC design is higher then for a discrete design
C2. SoC reduces the required PCB area
C3. If scaling is considered, it is desirable to implement as much as possible of the design in the digital domain
C4. A trend in SoC is to replace digital logic with software solutions
C5. SoC is typically designed around a microcontroller core

d) We want to expand an existing system. The desired expansion requires more physical interrupt line then what is available. It is decided not to change any existing components. To solve the problem a three input OR gate is used to share an interrupt line, see figure below. Introducing a shared interrupt line has many consciences. What claim is correct?



D1. If an interrupt occur on IRQ 2 line a software test must be conducted to identify the correct source causing the interrupt
D2. The registers IRQ-mask, IRQ-priority and IRQ-register must be expanded by two bit
D3. Only IRQ-mask must be expanded by two bit
D4. Only IRQ-priority must be expanded by two bit
D5. Only IRQ-register must be expanded by two bit

e) Which one of the following statements about power and energy consumption is **not** correct (alternatively that choice 5 is correct), given a system with a 16-bit microcontroller with 8 general 16-bit registers, 16-bit fixed instruction size, 128KB of on-chip shared cache for instructions and data as well as 16MB of off-chip DRAM?

E1. Increasing the cache size will always result in equal or lower energy consumption
E2. Efficient register utilization will be important in order to maintain low energy consumption
E3. If a program is to access all elements in a C array: `int myarray[64][64][64]`, the order of access will influence the energy consumption
E4. The energy cost of a single instruction of a program is variable
E5. All the above statements are correct

f) Given the following statements, which ones are correct for the following expression of a C program?

```
for ( n = 0 ; n < A*B ; n++ )
  for ( m = 0 ; m < C ; m++)
    x[n][m] = y[n][m];
```

1. The expression can be optimized using code motion
2. The expression can be optimized using induction variable elimination
3. The expression can be optimized using dead code elimination
4. The addresses for accessing the array must be computed run time
5. Loop unrolling could reduce the loop overhead

F1. 1, 2, 3, 4 and 5
F2. 2, 3, 4 and 5
F3. 4 and 5
F4. 1, 2, 4 and 5
F5. Another combination

g) Which one of the following statements about processes is **not** correct?

G1. Context switch frequency can influence cache utilization
G2. A process requesting data to be fetched from main memory would typically be placed in a *waiting* state by the scheduler
G3. Semaphores can always be implemented in a program by executing two instructions, one testing a value and the other setting the value based upon the previous test.
G4. POSIX supports choosing of a scheduling policy for each process
G5. Co-operative multitasking is vulnerable with regards to processes that stop responding

h) Which one statement about networks and communication is **not** correct?

H1. The OSI model is a 7 layer abstraction of network communication
H2. The I^2C bus uses two lines, SDL (serial data line) and SCL (serial clock line)
H3. One I^2C bus can have multiple masters
H4. An I^2C transmission includes a CRC field for fault detection
H5. A CAN bus can use a twisted pair as its transmission medium

i) Which one of the following statements about Linux device drivers is **not** true?

I1. Device drivers are implemented as kernel modules
I2. Call of the following function will let the kernel allocate device's major number.:

```
#include <linux/fs.h>
int alloc_chrdev_region(dev_t *dev, unsigned int firstminor,
unsigned int count, char *name)
```

I3. A device driver makes a call to the follwing function, and the call returns NULL. As a consequence, the device *name* will not be able to use *n* ports starting from the port *first*.

```
#include <linux/ioport.h>
struct resource *request_region(unsigned long first, unsigned
long n, const char *name)
```

I4. Even if none of the functions declared in a driver's *file_operations* structure are implemented, a program can still use the driver.
I5. lsmod is a command used to get the list of the loaded modules

j) The following process is written in VHDL:

```
process (x, y, z)
begin
        s1 <= x xor y;
        s2 <= s1 or z;
        w <= s1 nor s2;
end process;
```

Let x, y, z be input signals declared in the corresponding entity and let s1 and s2 be signals declared in the architecture. The process is run under simulation. Suppose that at one point under simulation the signals have the following values:

x	y	z	s1	s2	w
1	0	0	0	0	1

and then the given process is run. The signal values immediately after running the process under simulation will be:

J1.

x	y	z	s1	s2	w
1	0	0	0	1	0

J2.

x	y	z	s1	s2	w
1	0	0	1	0	0

J3.

x	y	z	s1	s2	w
1	0	0	1	0	1

J4.

x	y	z	s1	s2	w
1	0	0	1	1	0

J5.

x	y	z	s1	s2	w
1	0	0	1	1	1

Student number:

Program of study:

Answering table:

Mark with a cross the box that gives the correct answer for each question. Be warned that the **answers are NOT provided in order**. Double check that your crosses provide the intended answers.

a)	A1	A3	A2	A4	A5
b)	B5	B1	B3	B2	B4
c)	C4	C5	C1	C3	C2
d)	D2	D4	D5	D1	D3
e)	E3	E2	E4	E5	E1
f)	F1	F3	F2	F4	F5
g)	G5	G1	G3	G2	G4
h)	H4	H5	H1	H3	H2
i)	I2	I4	I5	I1	I3
j)	J3	J2	J4	J5	J1

Deliver only this answer table
Keep the questionare

REMEMBER TO WRITE BOTH YOUR STUDENT ID NUMBER AND PROGRAM OF STUDY

DO NOT TURN BEFORE BEING ALLOWED TO DO SO !