

**PRINCE OF SONGKLA UNIVERSITY**  
**FACULTY OF ENGINEERING**

**Final Examination:** Semester 1

**Academic Year:** 2009

**Date:** 20 December 2009

**Time:** 09.00-12.00 (3 hours)

**Subject Number:** 241-530

**Room:** A401

**Subject Title:** Parallel and Distributed Computing

**Exam Duration:** 3 hours

**This paper has 10 pages, 6 questions and 120 marks (30%).**

**Authorised Materials:**

- Writing instruments (e.g. pens, pencils).
- Textbooks, a notebook, handouts, and dictionaries are permitted.

**Instructions to Students:**

- Scan all the questions before answering so that you can manage your time better.
- Answers **must** be written in **Thai**.
- Write your name and ID on every page.
- Any unreadable parts will be considered wrong.

When drawing diagrams or coding, use good layout, and short comments; marks will not be deducted for minor syntax errors.

**Cheating in this examination**

Lowest punishment: Failed in this subject and courses dropped for next semester.

Highest punishment: Expelled.

NO	Time (Min)	Marks	Collected	NO	Time (Min)	Marks	Collected
1	40	32		5	30	25	
2	20	16		6	40	25	
3	10	10		Total	175	120	
4	15	12		Collected	30%		

**Question 1**

(32 marks; 40minutes)

a) Give 5 reasons for using parallel computing.

(5 marks)

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b) List 3 significant constraints in building faster serial computers. (3 marks)

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c) Compare the following interconnection media types.

(6 marks)

Shared medium	Switched medium

d) Explain how to do *automatic parallelization*, tell when to choose which method and inform the tradeoffs. (4 marks)

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- e) Compare *Uniform Memory Access (UMA)* and *Non-Uniform Memory Access (NUMA)*? (8 marks)

UMA	NUMA

- f) Explain the following Problems Associated with Shared Data. (6 marks)

Cache coherence	Synchronization

**Question 2**

(16 marks; 20 minutes)

Compare the advantages and disadvantages of the following ways to program parallel computers:

a) Extend compilers

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b) Extend languages

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c) Add parallel language layer on top of sequential language

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d) Define totally new parallel language and compiler system

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**Question 3**

(10 marks; 10 minutes)

Explain how and what are needed in implementing Cache Coherence in case of following situations in order to ensure different processors have same value for same address.

a) Local Shared Memory

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b) Distributed Shared Memory

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**Question 4**

(12 marks; 15 minutes)

**Tell** whether the following equations are parallelizable or non-parallelizable. Also show how to **decompose** the parts of the equations.

a)  $F(i) = F(i - 1) * F(i - 2) * F(i - 3)$

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b)  $F(x) = A(a) + B(b) + C(c)$

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c)  $F(j) = k * F(j-1) + G(j-3) * H(j-2)$

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d) For  $i = 1$  to 10

For  $j=1$  to 1000

For  $k=1$  to 5

$F(i, j, k) = (A(i)^k / B(j))$

When  $A$  and  $B$  are 1D arrays and  $F$  is a 3D array.

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**Question 5**

(25 marks; 30 minutes)

From the following code fragments, 1) explain how the code will be processed, 2) check if there is something wrong with the code, and c) correct it or suggest a better code.

a)

```
if (A > B)
#pragma omp critical
    B = A;
```

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b)

```
#pragma omp parallel private(i,j)
for (i = 0; i < NUMBER; i++) {
    x += A(i);
    y += B(i);
    if (x == y) {
#pragma omp single
        printf ("Exiting (%d)\n", i);
        break;
    }
#pragma omp for
    for (j = x; j < y; j++)
        c[j] = (c[j] - x)/y;
}
```

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e)

```
#pragma omp parallel sections
{
  #pragma omp section
  F();
  #pragma omp section
  G();
  #pragma omp section
  H();
}
```

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**Question 6**

(25 marks; 40 minutes)

Write a C program using OpenMP to parallelize the following **factorial** function, explain how your code works by using pictures or diagrams where it is possible.

$$\begin{aligned} F(n) &= n * F(n-1) \text{ if } n > 1 \\ &= 1 \text{ if } n = 1 \text{ or } 0 \end{aligned}$$