PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 1 **Academic Year**: 2008

Date: 29 July 2008 **Time**: 09.00-12.00 (3 hours)

Subject Number: 241-530 **Room**: R200

Subject Title: Parallel and Distributed Computing

Exam Duration: 3 hours

This paper has 11 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.

Question 1 (46 marks; 50 minutes)

a) Which type of problems is non-parallelizable? (2 mark)

b) What are factors that contribute to *parallel overhead*? (2 marks)

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

d) Compare *parallel computing* and *serial computing*. (6 marks)

Parallel computing	Serial computing

Name_____ ID_____

e) What are the differences between *communication* and *synchronization*?

(4 marks)

Communication	Synchronization

f) Compare the two Interconnection media types*:* *Shared Medium* and *Switched Medium*? (4 marks)

Shared Medium	Switched Medium

g) What and why do we need to identify when we are in the process of understanding the problem and the program which is the first step in developing parallel software? (6 marks)

h) What are the differences between *Uniform Memory Access (UMA)* and *Non-Uniform Memory Access (NUMA)*? (8 marks)

UMA	NUMA

i) Compare *Shared Memory* and *Distributed Memory* architecture? (10 marks)

Shared Memory	Distributed Memory

Name_____ ID_____

Question 2 (18 marks; 20 minutes)

Explain and **draw** the following Switched Network Topologies, and **tell** their tradeoffs.

a) 2D Mesh Network

b) Crossbar Network

c) Multistage Network

Name_____ ID_____

d) Hypercube Network

e) Tree Network

f) Ring Network

Question 3 (16 marks; 20 minutes)

From Amdahl's Law, find out the speed up if the scenario as follows.

a) Explain the effects of each parameter in the Amdahl's law

b) Find the speedup when there are 2 processors and 40% parallelizable code

c) Find the speedup when there are 2 processors and 80% parallelizable code

d) Find the speedup when there are 10 processors and 40% parallelizable code

e) Find the speedup when there are 10 processors and 80% parallelizable code

f) Find the speedup when there are 100 processors and 40% parallelizable code

g) Find the speedup when there are 100 processors and 80% parallelizable code

Question 4 (10 marks; 10 minutes)

Explain the following problems associated with shared data and how to solve the problems.

a) Cache Coherence

b) Synchronization

Question 5 (10 marks; 10 minutes)

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

a) G(i) = G(i - 2) - G(i - 1) + G(i - 3)

b) H(a) = A(a) + B(a)

c) F(J+1) = 9.0 * F(J) + X(j) * W(j)

d) K(n) = K(n-1) * n if n > 0 and = 1 if n = 0

e) F(x,y,z) = (square root of $((x+y)^2 - (x-z)^3)$) /xyz

Question 6 (20 marks; 40 minutes)

Write ***Data Dependence Graph*** and ***pseudo code using the MPI operations*** that parallelizes the following execution.

For i = 1 to 10

For j=1 to 1000

For k=1 to 5

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

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