



Name : .....  
Roll No. : .....  
Invigilator's Signature : .....

**CS/M.Tech (CSE)/SEM-2/PGCSE-202(B.L.)/2013**

**2013**

**ADVANCED COMPUTER ARCHITECTURE  
(BACK LOG)**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

Answer question no. 1 and any *two* from the rest.

1. Write short notes on the following :  $4 \times 5 = 20$ 
  - a) Data Parallelism
  - b) Control Parallelism
  - c) PRAM Model
  - d) Ahmdal's Law
2. Prove that the total number of mesh points  $k$  or fewer jumps away from an arbitrary point in a 2D mesh is  $(2k^2 + 2k + 1)$ .  
(Ignore the case where the point is less than  $k$  jumps from the edge of the mesh.)  
Hence prove that a complete binary tree of height greater than 4 cannot be embedded in a 2D mesh without increasing the dilation beyond 1.  $15 + 10$



3. a) State and prove Brent's theorem.  
b) Prove that :  
A p-processor PRIORITY PRAM can be simulated by a p-processor EREW PRAM with the time complexity increased by a factor of  $\Theta(\log(p))$  (p is an integer). 10 + 15
4. a) Show a dilation-1 embedding of an  $8 \times 2$  mesh into a hypercube. Your diagram should clearly indicate which mesh position number gets mapped to which processor number on the hypercube.  
b) Write a CREW PRAM algorithm of your design that will automate the mapping in part (a). 10 + 15
5. a) Give a PRAM EREW algorithm for colouring a graph (with  $n$  nodes) with  $c$  colours so that no two adjacent vertices are assigned the same colour.  
b) Find the complexity of this algorithm (using theta notation). Find the number of operations performed by this algorithm (using theta notation). 15 + 10
6. Describe the structure of a de Bruijn network. Draw a de Bruijn network connecting 16 nodes. Prove that the diameter of such a network with  $2^k$  nodes is  $k$  (where  $k$  is an integer). 5 + 5 + 15