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**MANIPAL INSTITUTE OF TECHNOLOGY**  
 (Constituent Institute of Manipal University)  
 MANIPAL-576104



**VI SEMESTER B.TECH(CSE) DEGREE END-SEMESTER EXAMINATION**  
**MAY 2015**  
**SUBJECT: PARALLEL COMPUTER ARCHITECTURE AND PROGRAMMING**  
**(CSE 306)**  
**DATE: 11-05-2015**  
**TIME: 3 HOURS** **MAX.MARKS: 50**

**Instructions to Candidates**

- **Note:** Answer any **FIVE** full questions.

1A. Define ILP. When Name dependency will occur between two instructions? Name and discuss the types of name dependency between a instruction  $i$  that precedes instruction  $j$  in program order with appropriate example.

1B. For the following reservation table of a pipeline processor, give the forbidden latency list F, collision vector C, the state transition diagram, all simple cycles and greedy cycles, Optimal constant latency, MAL, efficiency, throughput and maximum throughput of the pipeline. Assume  $\tau=20\text{ns}$ .

	1	2	3	4
$S_1$	X			X
$S_2$		X		
$S_3$			X	

**(4 + 6)**

2A. Starting from fundamental principles discuss the classification of parallel computers based on degree of parallelism.

2B. Write the algorithm to multiply two  $n \times n$  matrices with  $n^2$  PEs. Show all the figures required for the above algorithm. **(5 + 5)**

3A. Write a detailed note on Models for communication and memory architecture in multiprocessor systems.

3B. Explain with example cache coherence problems in multiprocessor system. When do you say memory system is coherent? Explain different methods to maintain coherence for multiple processors using snooping protocol with example. (5 + 5)

4A. Write a MPI Program to read two strings S1 and S2 of same length in the root process. Using  $m$  processes including the root (where  $m \leq \text{string length}$ ), produce the concatenated resultant string as shown below. Display the resultant string in the root process. Write the program using Collective communication routines.

Eg :

String S1: hello

String S2: local

Resultant String : hleolclao!

4B. What problem may occur when multiple processes working concurrently to update the data stored in a common memory in a shared memory programming model? How do you solve this problem? Explain with an example. (6 + 4)

5A. Write down the principles and disadvantages of Superscalar execution and VLIW. With appropriate example explain time-sliced version of chip multithreading.

5B. It is required to find out the execution time taken by kernel function of an OpenCL code. Write down the complete code snippet required to do this. (5 + 5)

6A. Write a kernel which receives an input matrix of size  $m \times n$ . It produces an output matrix of size  $m \times n$  such that, each element of the output matrix is calculated in parallel. Each element in the output matrix is a total sum of row sum and column sum of those elements that lies in the same row and same column index of that element in the input matrix.

Example:

1	2	3	O/p: 11	13	15
4	5	6	20	22	24

6B. For the OpenCL program that calculates the value of  $\pi$  using the below formula parallelly, write the

a) kernel code

b) Global and Local Worksize needed

c) The code starting from clEnqueueNDRangeKernel needed for the successful summation as below

$$\frac{\pi}{4} = \frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} \dots \dots$$

(5 + 5)